September 14th, 1929 15 CENTS

RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

390th Consecutive Issue—EIGHTH YEAR

PREVIEW OF HB COMPACT FOR AC

See Pages 10 and 11 for a Discussion of the HB Compact

YEAR'S BUSINESS REACHED $ 10,000,000

GOVERNMENT ACTS TO IMPROVE DX

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, President and Treasurer, 145 West 45th Street, N. Y.; Herman Bernard, Secretary, 145 West 45th Street, New York, N. Y.

Polo 245 Power Supply

Scientifically Engineered, It Insures Superb Performance

THE Polo 245 Power Supply consists of a filament transformer, a high-voltage (plate) winding and two separate chokes, all for powering 224, 227, 228 and 245 tubes. The output may be a single 245 or two 245s in push-pull, because the chokes are large enough and strong enough to handle 100 milliamperes, while the power tube filament winding will easily take care of the two 245s. The entire supply is exceedingly compact and will fit in a cabinet that has the usual 7" high front panel. The high-voltage winding is of sufficiently high AC voltage to produce full 300 volts when the maximum direct current through any part of a voltage-dividing resistor is 80 ma. Of the 300 volts 250 are applied to the output tube's plate and 50 to its grid for negative bias.

All windings except the primary (110 volts, 50 to 60 cycles) are center-tapped, including the 5-volt winding for the 280 rectifier tube. The impedance bridge method is used for establishing the electrical center. Taking the positive rectifier voltage from the center of the 5-volt winding, instead of from either side of the filament, is a small extra advantage, but shows an extra stroke of careful workmanship to insure superb performance.

Another interesting point is that the high-current winding for all the 2.5-volt AC tubes to be used in a receiver or amplifier is rated at 12 amperes. This means that six heater type tubes may be worked well within the limits of the winding (total of 10.5 amperes used), while seven tubes may be used with the permissible excess of only .25 ampere over the rating (total 12.25 amperes). Of course the two or three other tubes (280, 245) are additionally supplied, from their individual windings. Hence a total of ten tubes may be worked (including 245 push-pull and 280 rectifier).

This is no mere estimate, but a scientific fact. The wire used on this 12-ampere winding is the equivalent of No. 9. Please read our chief engineer's report herewith.

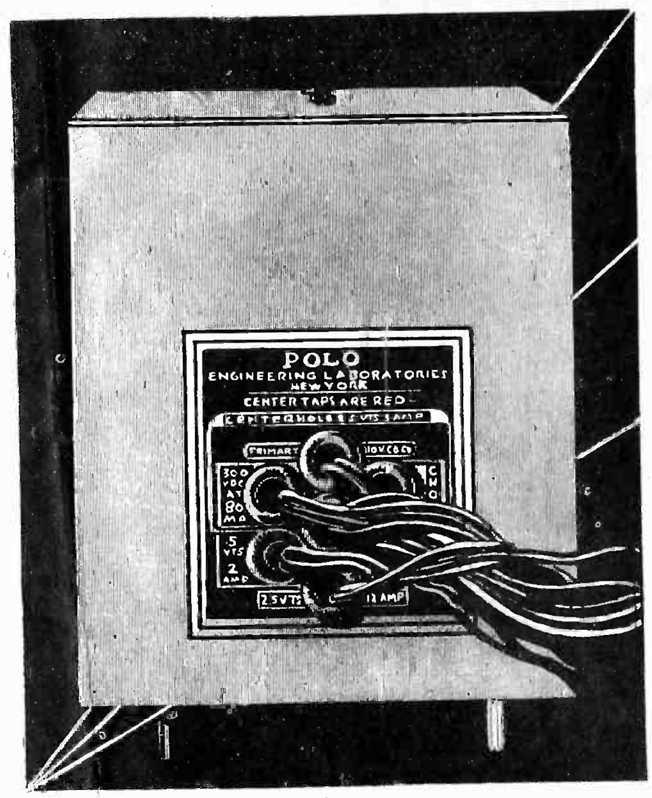
The two chokes are 50 henries each, and each choke is on a saparate core.

The 245 Power Supply weights 16 pounds. The shipping weight is 17 pounds.

For 40-cycle current, 110 volts, a special supply 2" higher, is made. Cat. P245, S40 (Code Cyclone). Price $13.50.

The 245 Power Supply, with chokes, is made also for 25 cycles, 110 volts. Only this particular combination is made for 25 cycles, although the filament-plate supply (less chokes) and the filament supply (less chokes and high-voltage winding) are made for 90 cycles.

For 25 cycles order Cat. No. P245 S 25 4⅝" wide x 5⅛" front to back x 9⅛" high. Shipping weight 25 lbs. (Code Cypress) at....................$14.50



Polo 245 Power Supply, including two chokes built in, size 4⅝" wide x 5⅛" front to back, 6⅛" high. Cat. No. P245 PS 110 volts, 50-60 cycles (code Cyclops)....................$10.00
Cat. No. P245, S40, for 40 cycles, 110 volts; size 4⅝" front to back, by 8⅛" high (code Cyclone)....................$13.50

Chief Engineer's Report on Polo 245 Power Supply

By Walter J. McCord, Chief Engineer

Every precaution has been taken to produce a 245 power supply of superb performance, and in proof thereof I take pleasure in submitting for close study by engineering minds the specifications followed, with advice to novices.

(1)—Overall dimensions of the casing, 4⅝" wide x 5⅛" front to back x 6⅛" high.

(2)—Filament and plate secondary windings as follows: 724 volts at 100 mils, center tapped at 362; 5 volts at 2 amperes, center tapped; 2.5 volts at 3 amperes, center tapped; 2.5 volts at 12 amperes, center tapped.

(3)—Two 50-henry chokes, DC resistance of each, 420 ohms.

(4)—Primary draw with all secondaries worked at maximum, 88 watts.

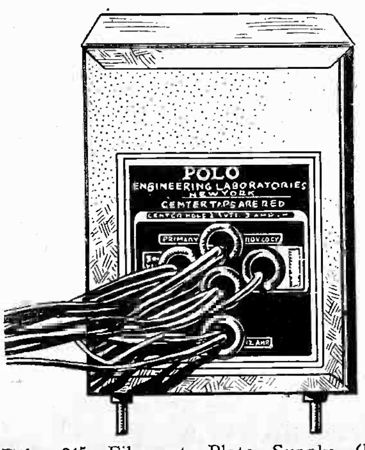
(5)—One transformer core with 1" x 1¾" cross-section; window opening 2⅛" x ¾". Two choke cores with ⅞" x 1¾" cross-section; window opening ½" x 1¾"; .014" air gap. The laminations are stamped from high-grade Silicon sheet steel having 1.92 watts loss per pound. The joints in the transformer are all overlapping, holding the magnetic leakage to a minimum.

(6)—Size of wire and resistance of each winding as follows: Primary—No. 24 wire, DC resistance, 5.2 ohms. Plate Sec.—No. 30 wire, DC resistance, 104.5 ohms. 5 v.—No. 18 wire, DC resistance, .102 ohms. 2½ v., 3 a.—No. 18 wire, DC resistance, .051 ohm. 2½ v., 12 a.—.059 x .180 rectangular wire (equals approximately No. 9 wire), DC resistance, .008 ohm.

(7)—Total weight of block 16 lbs.

(8)—Casing is made of sheet steel and is cadmium plated. Four ¾" mounting screws are placed in the bottom, permitting the block to be mounted to the base, in a very small space, as no space is required for mounting flanges.

(9)—Care should be taken in connecting the leads so that none of the secondaries is shorted. A shorted secondary, either a direct short or through a defective condenser, soon will burn out a transformer. Care should be taken also in connecting the primary to the proper current. The primary should be connected to 110 v. 50-60 cycles AC, never to 220 volts, neither should it be operated on a line voltage of 130 or over.



Polo 245 Filament Plate Supply (less chokes) is 4½" wide, 5" high, 4" front to back. Weight 9 lbs.

FILAMENT-PLATE SUPPLY

The Polo 245 Power Supply, less the two built-in chokes, is available to those desiring to utilize chokes they now have, and who do not find the compactness afforded by the consolidated unit absolutely necessary.

The Filament-Plate Supply has the same voltages on the secondaries, at the same ratings, as does the unit that includes the chokes.

Polo Filament-Plate Supply, consisting of five windings; primary 110 v., 50-60 cycles. Cat. No. PFPS (code Cymbal), $7.50.

Same as above, except for 40 cycles 110 v. AC. and a little greater height. Cat. P40 FPS (code Cylinder), $10.00.

FILAMENT SUPPLY

A filament transformer only, in a smaller container than any of the others, but with the same voltage and current ratings, provides 2.5 v. at 3 amperes, 2.5 v. at 12 amperes, 5 v. at 2 amperes.

The Polo Filament Transformer, consisting of four windings as described; primary, 110 v. 50-60 cycles. Cat. No. PFT (code Cyclist) $4.25.

Same as above, except for 40 cycle, 110 v. AC, Cat. P40 FT (code Cyanide), $6.25.

ALL PRICES ARE NET

Polo Engineering Laboratories, 57 Dey St., N. Y. City. Enclosed please find $——, for which ship at once the following:

P245 PS (code Cyclops)....................$10.00
P245 S40 (code Cyclone).................... 13.50
P245 S25 (Code Cypress).................... 14.50
PFT (code Cyclist).................... 4.25
P40 FT (code Cyanide).................... 6.25
PFPS (code Cymbal).................... 7.50
P40 FPS (code Cylinder).................... 10.00

In ordering by telegraph use code designations.

Name ....

Address ....

City.................... State....................

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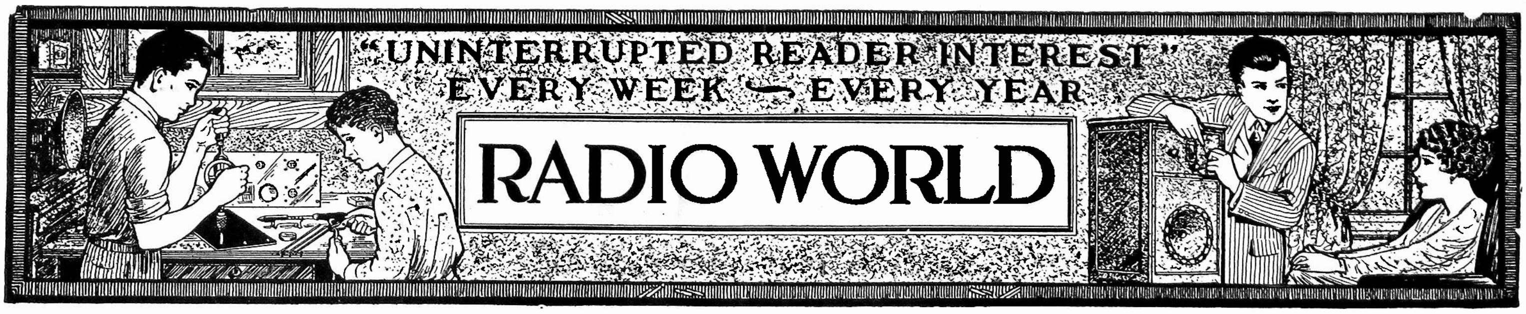
5-DAY MONEY-BACK GUARANTEE!



Vol. XV, No. 26 Whole No. 390
September 14th, 1929
15c per Copy, $6.00 per Year
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879.]

Technical Accuracy Second to None
Latest Circuits and News
EIGHTH YEAR

A Weekly Paper published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRYant 0558 and 0559

FARMS TO THE FORE!

Battery Receivers Give Them Real Results Now

By E. A. Nicholas

Vice-President, Radio-Victor Corporation of America.

WELL might the rural dweller who lives in an area unserved by electricity wonder why most radio manufacturers have concentrated their efforts on socket-power radio sets, while seemingly neglecting the battery radio sets, during the past few years. Radio means more to the rural home than to the city home.

To the farmer, radio spells a vital business service just as much as entertainment for leisure moments; and recently, broadcasting stations have come to recognize the farm listener as an important part of their listening audience, so that agricultural programs have been developed to a remarkable degree. Nevertheless, battery-operated sets, with the sensitivity, selectivity, simplicity, economy, volume and tone quality requirements comparable with socket-power radio sets, have been conspicuous by their absence from the market.

Speaker Cut the Knot

If we study broadcasting history, we note that the real split between the requirements of rural and city listener-in came along with the introduction of the loudspeaker in place of headphones. Until then, the usual battery radio set, especially when operated with dry cells, could serve both rural and city family equally well. However, with the introduction of the loudspeaker there arose a demand for more power and better tone quality, along with a decrease in operating cost, all of which inevitably led to socket-power operation.

Radio engineers immediately turned their efforts to harnessing the usual alternating current to the radio set, and in due course evolved AC tubes, rectifiers, powerful loudspeakers, and other features of the socket-power radio set. For the relatively limited direct current lighting areas found in some cities, satisfactory DC socket-power radio sets were developed later on.

Nevertheless the radio industry has not forgotten the rural home. It has, of course, concentrated its efforts on the wired home for the reason that the more immediate demands were in that direction. We learn that there are some 26,000,000 homes in the United States today, of which less than 9,000,000 are not equipped with electric light wiring. Of that 9,000,000, a fair proportion are in city and town, and may be considered the poorer class of homes and therefore the least promising radio prospects. Therefore, more attention has been directed to the 17,000,000 homes as against the five or six million rural homes.

Furthermore. until really helpful agricultural and rural programs could be developed and made available through stations scattered throughout the nation, the keenest radio interest largely followed the wired homes of the land.

Now radio engineers have turned to the requirements of the unelectrified home, eager to duplicate in that field what has been achieved for city and town radio enthusiasts. Starting out with current conservation as the foundation, they have evolved new and refined types of loudspeakers capable of supplying ample volume and rich tone from a minimum input.

Because of the relative inefficiency of loudspeakers in the past, it has been necessary to employ more tubes with a larger current drain. A small increase in drain means a considerable decrease in battery life. Hence battery sets of the past have not been very economical, unless loudspeaker volume and tone were lowered.

The recent development of the screen-grid tube with an amplification factor several times that of the usual three-element or standard battery tube, has also been a step in the direction of the ideal battery set. Indeed, with a single screen-grid tube replacing between two and three of the usual tubes for the radio-frequency end, and, when also used as the detector, replacing the first audio tube as well, battery current has been reduced to new low levels.

On a Par with AC

These current economies on the one hand, combined with the possibilities of greater volume and better tone through refined loudspeaker design, on the other, have made possible a battery-operated radio set about on a par with the average socket-power radio set, plus the advantage of a noiseless background for tuning distant stations which is so important for the listener who is a considerable distance from the centers of population.

Just as the wrist watch can compare with the alarm clock in the matter of performance, despite the great disparity in power required for operation, so will the new battery-operated radio sets for rural homes compare favorably with socket-power radio sets.

Segregated Filtration for Power Line Disturbances

Power line disturbances are increasing relatively with the growing use of electric appliances in homes, shops and factories, particularly in congested areas, and are especially troublesome with present-day socket-power sets of extreme sensitivity.

What are power line disturbances? Any form of electric spark sets up miniature radio waves. When these waves encounter wires or conductors, they are propagated far and wide. Thus electric motors of refrigerators, washing machines, sewing machines, vacuum cleaners, vibrators and so on, if they have sparking brushes, act as miniature transmitters. Electric sign flashers, X-ray equipment, violet-ray outfits, igniters of oil burners and other devices also may set up serious interference. Just as the turning on or off of the electric light in the same house as a radio set causes a disturbance that sounds as if the loudspeaker had been hit with a bean shooter, so the repeated impulses from electric motors, flashers or sparks cause disturbances that may interfere seriously with radio programs.

For quite a while the radio industry has been endeavoring with varying success to eliminate power line disturbances, since these constitute the figurative shoals of broadcast reception. The measures heretofore employed, however, have been more or less makeshifts. Some filters have filtered under certain conditions and positively refused to filter under others.

Engineers have reached some general conclusions:

First, that interference has to be segregated into two very definite classes, namely, interference that comes over the electric wires directly, and interference that is radiated.

Second, that there are two courses to follow in combating the interference causes, namely, to provide a filter to keep out undesired interference from the power line, and to provide a filter at the source of the disturbance, to kill radiation.

Photo-Cell Magic

Light on Plate Releases the Electrons

By J. E. Anderson

EVER since television seized the public fancy there has been a widespread interest in photoelectric cells. The advent of talking movies increased this interest so that now a photoelectric cell is spoken of almost as often as the vacuum tube used in radio receivers.

Many may think that the photoelectric cell is a new invention. The fact is that it is older than the vacuum tube. It is true that Edison discovered the underlying principle of the vacuum tube in 1884 and that Hallwachs explored the principle of the photoelectric cell four years later. But the Edison discovery lay dormant for many years whereas the photoelectric principle was explored immediately after its discovery. Hertz, the discoverer of electromagnetic waves, is credited with being the first to discover the photoelectric principle, and Hallwachs was the first to investigate the phenomenon.

The first to apply the "Edison effect" to radio reception was J. A. Fleming, an English physicist, who applied it as a detector in 1904. The photoelectric effect had been used some years earlier essentially in its present form, but it was confined to laboratory measurements and investigations. It was as late as 1907 that DeForest added the grid to the vacuum tube, thus producing the triode, based on the Edison effect.

The Photoelectric Effect

Just what is the photoelectric effect which is the basis of photoelectric cells? It is the release of electrons from a metal surface by light waves falling on that surface. The Edison effect, or thermionic effect, is the release of electrons from a heated metal. In many respects the two effects are similar, and, indeed, in some instances it is difficult to tell when electron emission is due to light or to heat.

Electrons are released by heat and light from a metal in free air, but the rate is enormously increased when the electrons are inclosed in an air tight envelope from which all air can be pumped. It is for this reason that thermionic tubes and photoelectric cells always come in vacuum tubes of glass or quartz.

Just as an enormous amount of information has been collected on thermionic tubes, so much has been collected on photoelectric cells, but due to the greater commercial application of the thermionic tube, more has been done on that than on the photoelectric cell. However, the photoelectric cell is daily finding more applications, and possibly more work is being done now on this tube than on the thermionic tube.

Jobs Aplenty for the Cell

Wherever light enters as a factor in any operation it is possible to put the photoelectric cell to work, and since light means color as well, wherever color is a factor the cell can find an application. A few examples will serve to emphasize the wide field of application. Cigars are graded according to the shade of color. Skilled workmen have previously done the grading by hand. Now photoelectric cells are used to sort the cigars according to the shade of color. One cell is adjusted to reject all cigars except those having a certain shade. These cigars the cell accepts and puts into a separate compartment. Other cells are adjusted to accept certain other shades.

Photoelectric cells are used in television and talking movies, as nearly everybody knows. They are also used for measuring light intensity from stars and from the sun. For example, a cell can be used to record the total amount of sunlight during the day or the total amount of starlight at night.

The characteristic of the photoelectric cell is that the number of electrons released is directly proportional to the intensity of the light that is absorbed by the emitting metal surface. That is, the electric current through the cell is proportional to the light that enters. This is true for any one color of light. It is also true for white light, or for nearly white light as long as the color composition does not change.

It is not necessarily true that the current for light of one composition is the same as that for another composition even if the two lights appear to have the same intensity.

Current Depends on Wave-length

The amount of current that flows in any cell depends on the wavelength of the light that falls on the photo-sensitive surface. For every metal there is a long wavelength limit, above which no electron emission will take place no matter how intense the light may be. For example, the limit of one may be in the red. A cell the cathode of which is made of one metal will not respond to red light of longer wavelength or to infra red waves. Another metal may have its long wave limit in the ultra violet. A cell made with this metal will not be photosensitive in any part of the visible spectrum.

The higher the frequency of the light that enters a cell, the greater the current will be. But it should be remembered that the light that falls on the window of the cell does not have the same composition as the light that enters. The envelope is not equally transparent to all colors. In fact, to some colors the envelope may be absolutely opaque. For example, ordinary glass does not transmit the ultra violet light.

Hence if a cell is made with a glass envelope, there will be a short wave limit as well as a long wave limit. The response curve, plotting current against frequency of light, keeping other factors, such as intensity and applied voltage, constant, is similar to a resonance curve of a radio frequency tune. There is a definite maximum response at a frequency depending on the metal of the cathode and certain other factors.

Eye a Photoelectric Organ

The human eye has a similar response curve, which points to the possibility that the eye is a photoelectric organ.

In many applications of the photoelectric cell it is desirable that the response curve of the cell is the same as that of the eye, for example, in measuring illumination. If the cell "sees" the light the same as the eye, measurements are simplified.

From one point of view there are two types of photoelectric cells, the hard vacuum cell and the gaseous cell. The vacuum in the hard cell has been made as high as modern pump technique permits. Its characteristics are permanent and therefore it is suitable for refined measurements. But it is relatively insensitive.

The gaseous cell contains a small amount of an inert gas, such as helium, neon, argon and xenon. This cell is not as constant as the hard vacuum cell but is much more sensitive. It is used in most commercial applications.

The reason the gaseous cell is more sensitive is that in it the current is increased by ionization by collision. An electron starts from the cathode, or metal emission surface. It immediately gains in velocity under the accelerating force of the high voltage battery. An atom of gas gets in the way and there is a terrific collision. Other electrons are jarred loose from the atom. They in turn gain speed and finally collide with other atoms. The result is that the total number of electrons that reach the anode is many times larger than the number that left the cathode. Hence the current in the gaseous cell, for a given illumination, is many times greater than the current in a hard vacuum cell.

Book on Television

A B C of Television, by Raymond Francis Yates, published by Henley. ($3.00).

THIS new volume is a systematized account of the development and the present status of the art of sending and receiving visual signals by wire or radio. All the different systems that have been proposed or applied practically are treated in detail. Material which has appeared in various technical journals has been condensed and expressed in simple language to enable the non-technical reader to grasp the fundamental ideas. Much of the material which has appeared in popular journals has been expounded with scientific exactness and much new material has been included and expounded in the author's facile style.

Any one who reads this volume cannot fail to grasp the basic principles of television as well as to get a historical background of its development.

Some of the subjects treated in detail are Television Systems, Telegraphing Pictures, Photoelectric Cells, Amplifying Pictures, the Neon Lamp, Selenium Cells, the Problem of Scanning, Synchronizing Television, Transmitting Television at Home, and How to Make a Television Receiver.

The book contains 210 pages and is 6 x 8½ inches. It is profusely illustrated with halftone and line drawings of apparatus, characteristic curves and of circuits.

WHAT A COUNTER ABOUT

By Harvey

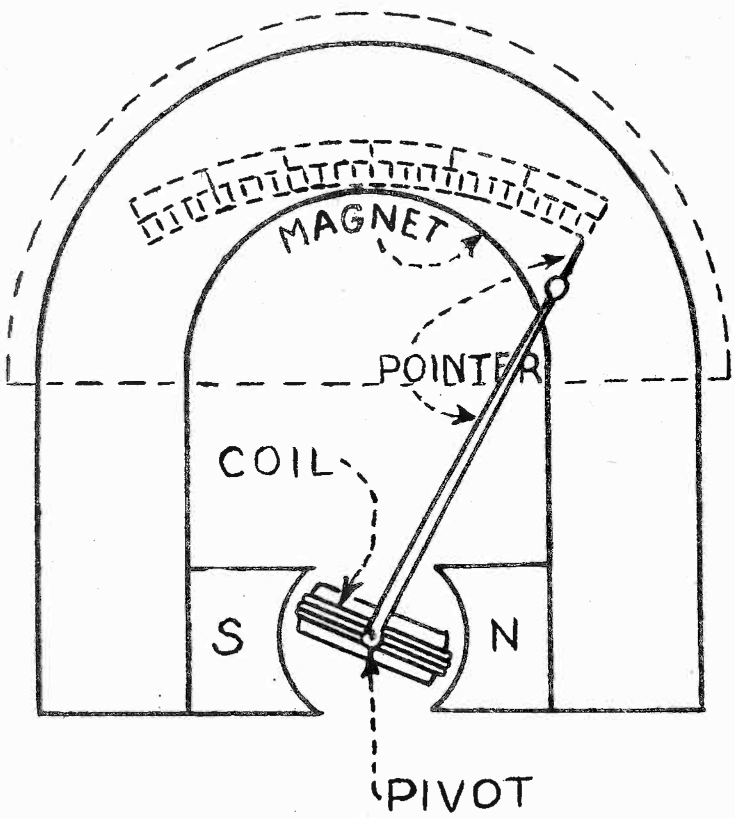


FIG. 1
THE D'ARSONVAL METER PRINCIPLE

SOME radio fans who are beginning to use volmeters and ammeters are much perplexed about the characteristics and uses of such meters. One fan, for example, bought an inexpensive milliammeter having a range of 0-300. When he got it the meter did not suit his purpose. So he returned the meter to the firm that had sold it to him and said that he would just as soon have a 0-1 milliampere meter and expressed a willingness to sacrifice the difference in price. His intentions were quite liberal, but his knowledge of meters was quite limited. The idea behind his offer was that if a 0-300 milliampere meter costs a certain sum a 0-1 milliampere meter costs 1/300 as much. If this idea were entertained by a single individual, there would be nothing to write about, but the fact is that many entertain the same idea, as countermen in radio stores can verify.

Now why should a 0-1 milliampere meter cost more than a 0-300 meter when it will only measure 1/300 as much current? We are reminded of a list of prices per ton of iron in various forms. Pig iron costs very little per ton. When this iron has been rolled out into sheets or drawn into wire it costs very much more. When the iron has been wrought into ornamental fences the price is still higher. When it is the main ingredient in fine steel and worked into cutlery, the price per ton has been multiplied manifold. When the steel has been made into hairsprings of a watch the price per ton has been multiplied thousands of times over the original price of the pig iron.

Refinements Cost Money

The same principle applies to electrical meters. A crude instrument which measures amperes is relatively easy to make and therefore costs little money. A milliammeter is harder to make and therefore costs more money. A very sensitive milliammeter like a 0-1 is still more difficult to make and accordingly is more expensive. The more sensitive a meter of a given type, the more expensive it is.

While the movements in two current meters may be the same in principle, that in one is much more delicate than that of the other. One requires refined bearings and extremely fine balancing; the other coarse bearings and just fair balancing. One requires a restoring spring as fine as the hairspring in a watch; the other needs only a relatively coarse spring.

Why does a high resistance voltmeter cost much more than one of low resistance? There are two reasons. The first is that the high resistance meter requires a sensitive milliammeter as indicator, and the higher the resistance per volt, the higher must the sensitivity be. Hence, in the first place, a high resistance voltmeter costs more than one of low resistance for the same reason that a low range milliammeter is more expensive than one of higher range.

The second reason is that a high resistance voltmeter must have accurate resistors of high value built in. These resistors often cost as much as the movement itself. Why are they expensive? Because they must be wound with special wire, whose resistance does not change with temperature. This wire is more expensive than ordinary resistance in the first place, and in the second it has a lower specific resistance so that more wire is required to give the necessary resistance.

And that is not all. The resistance must also be adjusted accurately to the correct value. This adjustment cannot be made by machinery in quantity production. It requires the work of a skilled workman. The accuracy of the meter is no greater than the accuracy with which this adjustment has been made. It is the cost of the resistors which accounts for the greater part of the difference between a meter of low resistance and one of high.

Measuring the Resistance Per Volt

The determination of the resistance per volt is a question which has caused some difficulty. As an example how it is sometimes attempted, we mention how one individual did it. He connected a 4.5 volt battery in series with the voltmeter and also in series with a milliammeter, as in Fig. 3. The deflection of the milliammeter was exactly 4.5 milliamperes. Hence, he concluded, the resistance of the voltmeter was 1,000 ohms per volt. That measurement and that reasoning would make any voltmeter having a total resistance of 1,000 ohms a 1,000 ohms per volt instrument. Of course, all that the measurement gave was the total resistance of the meter.

That is the first step in measuring the resistance per volt. The second and the final step is to divide the total resistance thus obtained by the full-scale reading on the voltmeter. Suppose the voltmeter had a range of 0-10 volts, as it did in this particular instance. The total resistance of 1,000 ohms must be divided by 10, which gives 100 ohms per volt. There is a great difference between an instrument having a sensitivity of 100 ohms per volt and one having 1,000 ohms per volt. One can be used for measuring the voltage of any battery but not for measuring the voltage drop in a resistance. The 1,000 ohms per volt instrument can be used for measuring either the drop in a resistance which is low compared with the total resistance of the meter or for measuring the voltage of a battery. If this particular instrument had been of 1,000 ohms per volt sensitivity, the total resistance would have come out to be 10,000 ohms, and the current on the milliammeter would have been .45 milliampere instead of 4.5.

Takes Precautions

When measuring the ohms per volt of a voltmeter it is well to take precautions against ruining the milliammeter used for measuring the current that the voltmeter takes. What happened in one instance when due precautions were not taken will be instructive. A dealer in meters submitted a sample voltmeter claimed to be a 1,000 ohms per volt instrument. The circuit given in Fig. 3 was hooked up, the meter A being a 0-1 milliammeter which had a list price of $12.00. The meter to be tested had a list price of $3.00

The battery E was chosen such that its voltage was a little less than the range of the meter to be tested. The claims made by the dealer for the voltmeter were discounted 50 per cent, and therefore a resistance was connected in series with the milliammeter which would make the current approximately .5 milliampere as a first trial. When the circuit was closed the needle of the milliammeter jumped instantly passed the 1 milliammeter point of the scale and stuck there permanently. A $12.00 meter had been ruined in measuring a $3.00 meter just because the enthusiastic claims of the dealer had not been discounted sufficiently.

It turned out that the sensitivity of the voltmeter was less than 100 ohms per volt.

Just to be on the safe side it is best to discount the claims for a meter 99 per cent. That is, when hooking up the circuit in Fig. 3, also include a resistance of so high a value that no damage can occur to the milliammeter. Or in place of using a high resistance in series, the voltage of the battery E can be made as low as possible. After a preliminary trial has revealed the approximate value of the resistance to be measured, either the battery voltage can be increased or the resistance in series can be reduced, if either is permissible without using a less sensitive milliammeter in the circuit.

MAN SHOULD KNOW METERS

Sampson

When measuring the resistance per volt by the methods suggested above, there are two voltages involved, the reading on the meter under test and the voltage of the battery in the circuit. Which shall be used for dividing by the current indicated by the milliammeter? That depends on the conditions. If the reading of the voltmeter under test can be trusted, this reading should be used. When it is, any external resistance in the circuit can be disregarded provided it is in series. The reading of the voltmeter gives the actual voltage across its terminals and that is what is wanted. The current through the meter is indicated by the milliammeter, since both meters are in series. Hence the reading of the voltmeter under test divided by the reading on the milliammeter gives the total resistance. To get the resistance per volt it is only necessary to divide this by the range of the voltmeter.

If the voltmeter cannot be trusted another voltmeter can be used for measuring the voltage of battery E. If there is no external resistance in the circuit, and if the internal resistance of the milliammeter is negligibly small, E divided by the reading on the milliammeter gives the total resistance of the meter under test. If the resistance of the milliammeter is not negligible but known, this resistance can be subtracted from the total obtained, and the difference is the resistance of the voltmeter.

Types of Meters

The best movement for a DC meter is the D'Arsonval type, which consists of a moving coil in a permanent magnetic field. This is illustrated in Fig. 1. A-shaped magnet maintains the field. Two specially-shaped pole pieces concentrate the field on the moving coil. Usually there is a cylindrical core inside the coil to aid in the concentration of the field and in increasing the magnetic flux.

The method of mounting the moving coil in the field varies according to the sensitivity of the instrument.

In instruments of moderate sensitivity, which are the most familiar, the coils are mounted in two pivot bearings, frequently jeweled as in watches. In some instruments, especially sensitive microammeters, there is only one pivot of this type, from which the coil is suspended. Such instruments require careful leveling. In very sensitive galvanometers, both of the wall-mounted and moveable types, the coil is suspended from a very fine phosphor bronze ribbon. This type also requires careful leveling.

The indicator used also differs. In most instruments a pointer is attached to the moving coil, and this point moves over a scale as indicated in Fig. 1. When a pointer is used it must be balanced very carefully not only in the direction of its length but also in the transverse direction. Any unbalance will increase the friction of the pivots in the bearings and reduces the sensitivity and makes the instrument erratic.

Instruments of highest sensitivity, usually of the wall-mounted type, have no pointer but employ a beam of light. A small mirror is mounted on the moving coil. An illuminated scale is mounted in front of the instrument and the numbers and graduations on this scale are reflected by the mirror into a telescope mounted directly in front of the mirror.

Principle of Instruments

The principle of the moving coil instruments is as follows: The current to be measured is led through the moving coil through flexible leads. This current makes the coil an electromagnet. There is an interaction between the permanent magnet and the electromagnet such that the moving coil tends to place itself so that the two fields are parallel, or so that the plane of the coil is at right angles to the direction of the permanent field.

This turning force is resisted by the suspension spring. In ordinary instruments the spring is like a hairspring in a watch. In the wall-mounted instruments the spring is the torsion in the suspending metal ribbon. The sensitivity of the instrument depends on the strength of the permanent magnet and on the weakness of the restoring spring.

From this explanation it is clear that a meter is like a spring balance in which the force of the current is weighed against the spring. There is another type of instrument, the electrodynamometer type, in which there are two coils connected in series, one fixed and one moving. The interacting forces are the same as in the D'Arsonval type. But this instrument measures either DC or AC. It measures AC because the fixed field reverses its direction at the same instant that the field in the moving coil reverses, so that the force between the two coils is always in the same direction. But this instrument is not suitable for sensitive instruments. It is used as a standard for calibrating other instruments.

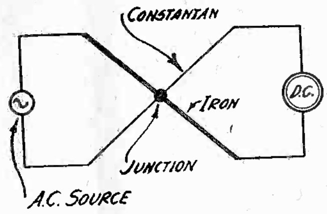


FIG. 2

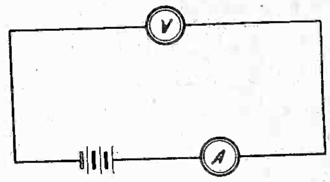


FIG. 3

LEFT—PRINCIPLE OF THE THERMO-COUPLE AC METER
RIGHT—CIRCUIT FOR MEASURING THE RESISTANCE OF A VOLTMETER

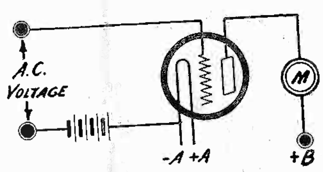


FIG. 4

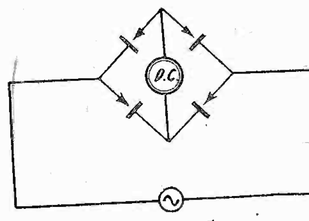


FIG. 5

LEFT—THE CIRCUIT OF A SIMPLIFIED VACUUM TUBE VOLTMETER
RIGHT—DRY DISC RECTIFIER CONNECTED FOR MEASURING AC VOLTAGES

Moving Iron Type

In many inexpensive meters the D'Arsonval movement is reversed. That is, the current-carrying coil is fixed in position and the permanent magnet moving and carries the pointer. These are known as the moving magnet type. This type measures only DC because the polarity of the moving magnet remains fixed. If the current in the fixed coil reverses, so does the force which causes rotation. Hence if the current alternates rapidly, the pointer will not move from the zero position.

The measurement of the resistance per volt on this type is done exactly the same way as for instruments of the D'Arsonval type.

Still another type of instrument is the moving iron vane type. This depends for its action on induced magnetism. Hence it operates on either DC or AC.

Instruments for measuring DC are available in all ranges from hundreths of amperes to millionths of a millionth of an ampere, and from tens of thousands of volts to a few microvolts. And these instruments come in many different types. But instruments for alternating currents and voltages are not plentiful, and those that are available are not very satisfactory. The most familiar and the most useful of instruments for AC are those that rectify the current or the voltage and in which the rectified current is measured with DC instruments.

The most familiar of the rectifying instruments are those which make use of a thermo-couple. A thermo-couple is a joint of two unlike metals. If this joint is heated, and if the other joint is kept at a low temperature, a current flows in one direction depending on the metals joined. This current can be measured with a sensitive DC instrument such as a microammeter. The junction can be heated in any manner whatsoever, for example by radiation from a hot body, by contact with a flame or by conduction from a hot body. One way of heating the junction is to send alternating current through it. This is done in thermo-couple type meters for measuring AC. Two unlike wires are crossed and welded together at the junction. An AC current to be measured is sent through the junction by two of the unlike leads and a microammeter is connected to the other pair. The DC current through the microammeter bears a definite relation to the AC heating current. Hence the AC can be measured with a DC instrument. A simplified diagram of a thermo-couple arrangement is shown in Fig. 2, the metals being iron and the alloy constantan.

The vacuum tube voltmeter, shown in Fig. 4, is well known. This is essentially a voltage rectifier.

A rectifying voltmeter which promises to be used much in the future is one employing dry rectifier discs such as are used in battery chargers and certain B power supply units. A circuit of this type is shown in Fig. 5. Four rectifier elements are used in a bridge formation. This particular instrument will be discussed more fully in the near future.

THE INSIDE FACTS ON

High Signal Amplitu

Overload Preserv

By J. E. Anderson an

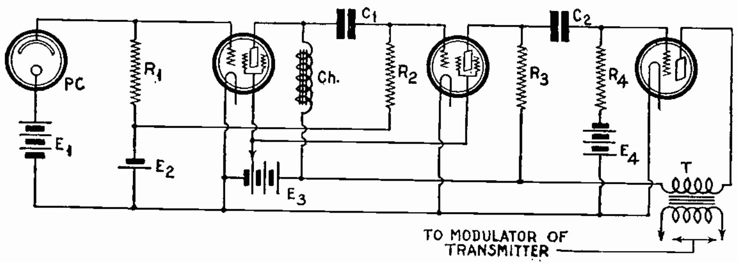


Fig. 90.

A COMPLETE AMPLIFIER OF PHOTOELECTRIC SIGNALS ESPECIALLY DESIGNED FOR STILL PICTURE TRANSMISSION

[*Herewith is sixteenth consecutive weekly instalment of J. E. Anderson's and Herman Bernard's book, "Power Amplifiers," which is being printed serially. The absorbing topic of power detection is discussed this week. Another interesting instalment will be published next week in the Show Number, dated September 21st.—Editor.*]

Fig. 90 is a complete amplifier for photo-electric signals as used in the Westinghouse picture transmitter developed by V. Zvorykin. It contains two battery type screen grid tubes and an output tube of the three-element type.

While this amplifier is intended for picture transmission it is equally suitable for audio signals such as those from a talking movie film. It would not be suitable for high-grade television signals because of the use of a choke coil and a transformer as coupling means, unless the choke and the transformer were designed to cover a frequency band from about 10 cycles to 50,000 cycles.

The value of the battery E1 would depend on the particular photo-electric cell used, and the value of grid bias battery E4 would depend on the tube that is used in the last stage. The value of E3 would be 135 volts, with the screen return set at 45 volts or lower on this battery. E2 should be a 1.5 volt cell.

The values of the various coupling resistors and condensers would depend on the service for which the circuit is intended. For television the stopping condensers C1 and C2 should be of the order of one microfarad to permit amplification of frequencies as low as 10 cycles. For frequencies in the voice and music range the stopping condensers need not be larger than .01 mfd.

The grid leaks, R1 R2 and R4, should be at least one megohm, except that R4 may have a smaller value. R3 should be of the order of 100,000 ohms.

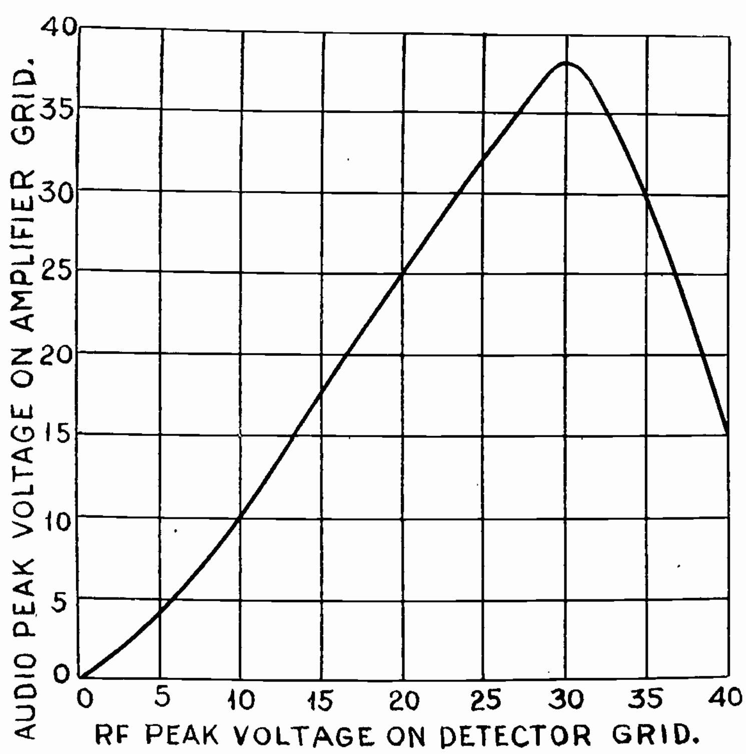


FIG. 91

A CURVE SHOWING THE PERFORMANCE OF A UY-227 TUBE AS A POWER DETECTOR WHEN FOLLOWED BY AN AUDIO FREQUENCY TRANSFORMER.

Power Detection

During the present year there has been much interest in so-called power detection, and it appears likely that this interest will increase until this form of detection is used almost exclusively in broadcast receivers.

The term power detection implies that the loudspeaker is connected directly in the plate circuit of the detector tube, without the intervention of any audio frequency amplifier. But this is not the present meaning of the term, for no successful receivers have yet been developed in which all audio frequency amplification could be omitted. It is probable that further development of receivers will make it possible to omit all amplification after the detector, but at this time at least one audio frequency amplifier must be used between the speaker and the detector.

Power detection at present simply means grid bias detection when the bias and the radio frequency signal applied to the grid of the detector tube are high. The output from such a detector is often so high that the input voltage to the tube following is sufficiently high to load up one of the medium power tubes.

One of the main advantages of power detection is that the audio output voltage is substantially linear, that is, proportional to the radio frequency signal. This practically eliminates the generation of harmonics from the detected voltage, and this is true even for radio frequency signals modulated 100 per cent. High percentage modulation was not permissible until power or linear detection was developed because of the excessive percentage of harmonic distortion that resulted when the old form of detection was used. On a square law detector the total harmonic distortion amounted to 50 per cent. of the entire output when the modulation was 100 per cent.

When power detection is used the amplification necessary is transferred from the audio side of the detector to the radio side, and the total amplification for a given output and strength of signal remains approximately the same.

The performance of a power detector is shown by the curve in Fig. 91, which gives the relationship between RF peak voltage on the detector grid and the AF peak voltage on the audio grid following the detector tube, the voltage having been stepped up by an audio transformer. The detector tube in question is a UY-227 with 180 volts in the plate circuit and a bias of 25 volts on the grid.

It is clear that the detection is substantially linear from zero up to 30 volts. There is only a slight departure from linearity for signal voltages less than 5 volts. The sudden drop in the curve for signal voltages higher than 30 volts is due to the load imposed on the tuned circuit by grid current. This load is not appreciable until the signal peak voltage exceeds the grid bias by 5 volts.

While this curve represents the output from the detector when the load on the tube is a transformer, essentially the same result is obtained when the load is a pure resistance. The absolute value of the output voltage would be different but the shape of the curve would be practically the same. For resistance coupling the curve would be more nearly linear and the detecting efficiency would be higher, but the greater efficiency would be offset by the absence of the transformer step-up.

The highest audio voltage in the curve is 38 volts, which is almost sufficient to load up a 171A type power tube. With a small increase in the plate battery voltage and a suitable increase in the grid bias, the output would be ample to load up this power tube.

When it becomes necessary to increase the plate and the grid voltages to insure a greater output voltage, the curves in Fig. 75 can be used as a guide. For any given value of plate battery voltage the grid bias should be adjusted until the plate current is nearly zero. Suppose, for example, that the plate battery voltage is 220 volts. The plate current for this voltage is practically zero when the grid bias is 30 volts negative, or

POWER DETECTION

[...]de Handled Without [...]es Tone Quality

[...]d Herman Bernard

the plate current is about the same for 220 volts on the plate and 30 volts on the grid as for 180 volts on the plate and 25 volts on the grid. Since the grid voltage has been increased by five volts, it is clear that the signal voltage that may be impressed on the tube can be increased by the same amount before appreciable grid current will flow. Therefore, with 220 volts in the plate circuit and 30 volts on the grid, the output voltage would be 43 volts where it was only 38 when the voltage in the plate circuit was 180 volts.

The best way of getting a negative bias, from the electrical point of view, is to use a battery of suitable voltage. For a heater type tube this should be connected as indicated in Fig. 92, the positive of the battery being connected to the cathode and the negative to the grid return lead, or to the low potential side of the tuned circuit. It is well to connect a condenser C1 of about .01 mfd. across the battery.

While a grid battery is desirable from the electrical point of view, it is not so convenient as voltage-drop methods employed in alternating-current circuits. For various methods of obtaining bias, the reader is referred to the discussion of Figs. 37 to 40, inclusive.

Since the plate current in a power detector is very small, it would require an enormous grid bias resistor if the plate current alone were to establish sufficient drop in it. Such a resistor would render the circuit insensitive. To avoid this difficulty the detector circuit can be arranged as shown in Figs. 93 and 94. The grid bias resistor R1 is connected between the grid return and the cathode and an additional resistor R2 is connected between the cathode and the B plus terminal. The values of these two resistors are proportional, so that the total voltage applied across the two in series is suitably divided between the grid and the plate circuits. This can be done to a first approximation on the assumption that the plate current is negligible compared with the current through R2 and R1.

Suppose the total voltage impressed across the two resistors is 220 volts. We can arbitrarily assign a value of 5,000 ohms to R1 and then determine R2 so that the voltage is suitably divided. We can also assign any bias we please provided we are guided by the curves for the tube in question. We found that when the plate voltage is 180 the grid bias should be 25 volts, and also that when the plate voltage is 220 the bias should be 30 volts for the 227 tube. When the total voltage is 220 volts the bias should have a value between these two. Let it be 28 volts. If the voltage drop in R1 is 28 volts and the resistance is 5,000 ohms, the current through R1 will be 5.6 milliamperes. Since we can neglect the current through the tube, this current will also flow through R2. The voltage drop in R2 will be 220 less 28 volts, and therefore the value of R2 must be 34,300 ohms.

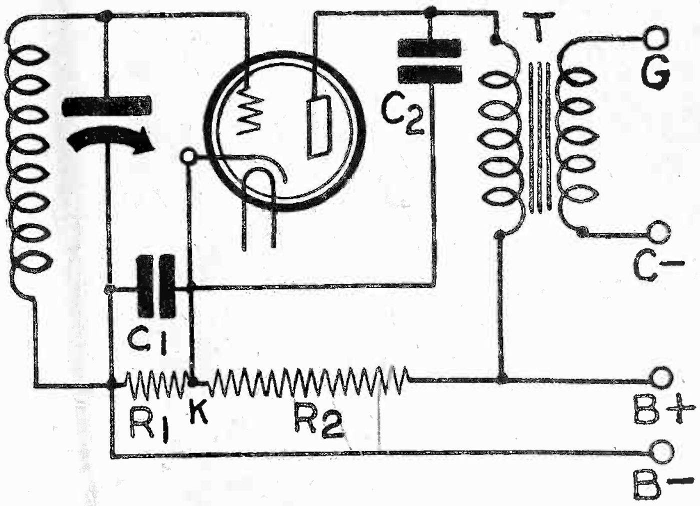


FIG. 93

IF A VOLTAGE DROP IS USED FOR GRID BIAS IN POWER DETECTION AN ARRANGEMENT LIKE THIS WILL MAKE THE CIRCUIT MORE EFFECTIVE.

If the power supply is capable of delivering considerable current the values of both these resistors can be lowered to advantage, but in lowering them the same ratio should be maintained between them. The greater the current that flows through R2, the less the effect on the bias will the current that flows through the tube have.

Instead of selecting a value for R1, R2 may be fixed at the beginning and R1 determined so as to provide the correct bias. For example, we might start by assigning a fixed value of 15,000 ohms to R2. What should R1 be to give a bias of 28 volts, neglecting the current that flows through the tube? We have already found the ratio that should exist between the resistors. Therefore we have 15,000 is to 34,300 as the unknown resistor is to 5,000 ohms. That is, the value of R1 should be 2,187 when R2 is 15,000 ohms. R1 then may be a variable resistor which can be set at 2,187 ohms. The current that will flow through R1 and R2 will be about 12 milliamperes.

Since the current through the tube will be a small fraction of one milliampere, as is evident from Fig. 75, the bias on the tube will be determined almost entirely by the current through R2.

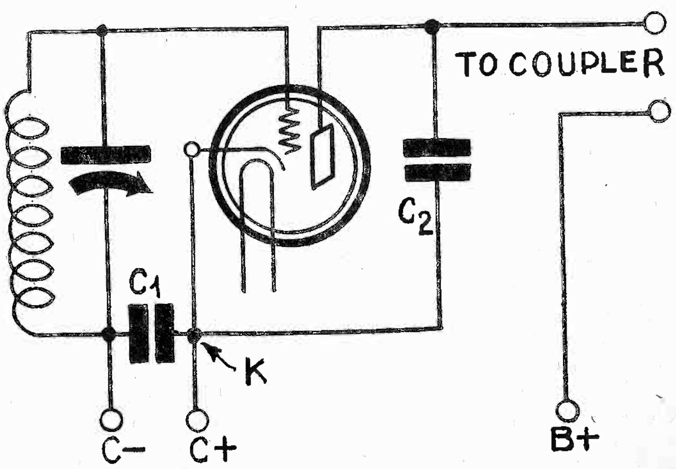


FIG. 92

ARRANGEMENT OF THE GRID CIRCUIT WHEN A BATTERY IS USED FOR SUPPLYING THE GRID BIAS REQUIRED FOR POWER DETECTION.

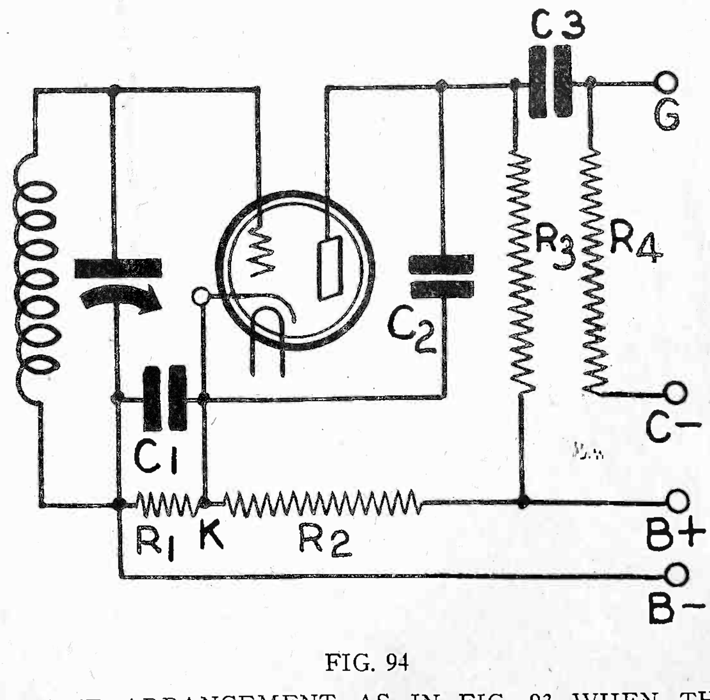


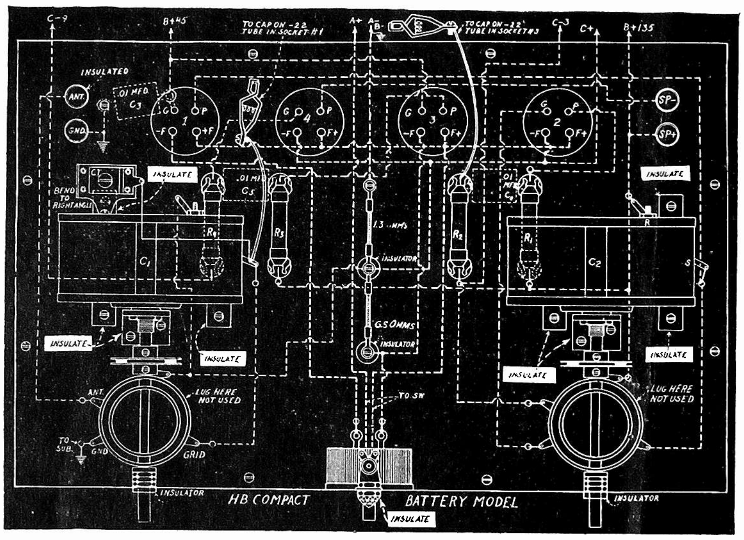
FIG. 94

SAME ARRANGEMENT AS IN FIG. 93 WHEN THE LOAD ON THE TUBE IS A TRANSFORMER. R2 IS USED TO AUGMENT THE CURRENT THROUGH R1.

TROUBLE-SHOOTING

Intimate, Authoritative Advice on Attaining

By Herman



PICTORAL DIAGRAM OF THE WIRING OF THE HB COMPACT, BATTERY MODEL, WITH THE POINTS TO INSULATE ESPECIALLY EMPHASIZED. THESE INSULATION PRECAUTIONS APPLY ONLY IF A METAL CABINET AND A METAL SUBPANEL ARE USED. THE CONDENSERS ARE MOUNTED TO THE SUBPANEL BY INSULATED BRACKETS. THE PICTORIAL DIAGRAM WAS PUBLISHED FULL-SCALE SIZE IN THE AUGUST 31ST ISSUE.

[Herewith is published an article on trouble-shooting in connection with the HB Compact, battery model. This receiver is most remarkable in its performance, especially on sensitivity, volume and tone quality. It uses a new type of coil, known as the Bernard tuner. The coil in the present circuit not only enables maximum practical amplification from the 222 tube by tuning the plate circuit, but insures covering the entire band of wavelengths.

Preliminary discussion of the battery model was published in the July 27 and August 3 issues, while some introductory facts on the AC model were published in the August 17 issue. The actual constructional series on the battery model was begun in the August 24 issue and continued in August 31, with full-size pictorial diagram and September 7 issues. Now that the trouble-shooting features are expounded there remains only the answering of questions on the battery model, and this will be done in next week's issue, the Show Number of RADIO WORLD, *dated September 21, while in that same issue the series on the construction of the AC model of the HB Compact will be begun.*

How the AC model is built into the same small-sized cabinet as the battery model may cause many to wonder, but a glimpse of the preview of the AC circuit, shown on the front cover this week, will clear up some of the mysteries, while next week the exposure will be complete.

All interested in this amazing receiver, in battery or AC form, should read the details printed in the July 27, August 3, 17 and 24 and 31, and September 7 issues, as many features common to both circuits were printed in each article. Such information included data on winding and using the dynamic tuners.—Editor.]

REMEDIES for trouble encountered in the HB Compact will be discussed under two groups: examples individual to this circuit and examples more or less applicable to all battery-operated circuits.

The first point of diagrammatic distinction between this circuit and nearly all others is that the primary of the screen grid tube's plate circuit is tuned. The plate circuit is at a high B potential at all points, hence if no signals are heard it may be because the B battery is shorted through the tuning condenser C2. If this condenser is not insulated from a metal subpanel which is grounded and goes to B minus, then for a certainty there is a short. Remedy it by insulating the tuning condenser. Of course any brackets used to support the condenser, if these are metal, must be insulated likewise. Drill a hole large enough to permit the collar of an extruded insulator to be inserted from the bottom of the subpanel toward the top, and at top put a flat, collarless insulator. Then you can tighten down a nut on a machine screw, without touching the subpanel, and your insulation is complete for this joint. Repeat the process for all joints.

Also C1 may short out the 1.3 ohm filament resistor, causing unduly high voltage on all the tubes, about 5½ volts on the 5 volt tubes and more than 4 volts on the two others. If this high filament voltage obtains, then C1 is shorting the smaller section of R6, because the condenser is connected to the subpanel, which is grounded A minus and B minus, hence both sides of the 1.3 ohm resistor mistakenly go to ground and A minus. Insulate C1 as previously suggested for C2, and include brackets for C1 in the process.

Dynamic Coils Used

The circuit uses a new system of tuning, whereby a rotary coil is connected in series with a fixed winding, and the tuning condenser, with shaft coupled to the rotary coil's shaft, is connected electrically across the entirety of the series windings. This method causes the dynamic coil to add maximum to the inductance in one position of parallel coupling, and to subtract maximum from it in the opposite parallel position. At intermediate points the addition or subtraction is less, while at the central point, or middle of the dial scale, the dynamic coil behaves as if it were a fixed coil.

Since the plate circuit of the screen grid tube is tuned, and has coupled to it a higher inductance coil, for input to the detector grid, there is a large distributed capacity. One of the objects of using the new coils, the Bernard tuners, is to get around this difficulty, covering the full broadcast band of wavelengths, and some wavelengths additionally, where otherwise it would be impossible to cover them all.

Remedy for Dissimilar Tuning

Both of these considerations—the use of the Bernard tuners in any form of circuit, and the fact the plate circuit of the screen grid tube is tuned—give rise to tuning phenomena.

Perhaps the one of first importance is the difference in dial settings. This is due to the distributed capacity present in the tuned plate circuit. Starting with a high capacity, naturally lower dial settings prevail, as compared with the first tuned circuit. This is because the distributed capacity is equivalent to a fixed capacity in parallel with C2. Hence C2 need contribute less capacity than otherwise, hence the lower dial settings.

The remedy for unequal dial settings is to put across the first tuned circuit a fixed capacity equal to the distributed capacity in the second tuned circuit. Just what this capacity should be can not be foretold, as it will differ in some instances, but in all instances the correct capacity can be found. An equalizing condenser of 80 or 90 mmfd. has been suggested, but it is likely this will not prove sufficiently high, so a larger one may be used, or two equalizers used in parallel. The object is merely to make the dials track. Even if the equalizing condenser is wholly omitted, the full broadcast band will be covered, since the Bernard tuner accomplishes this in the second tuned circuit, the only one that would escape full coverage, while the Bernard tuner in the aerial stage is simply to enable dial-tracking.

Any adjustable condenser used as an equalizer (CT) is not panel-mounted and not molested after the adjustment is finally made. A station is tuned in, preferably around 250 meters or lower, and the first dial is turned to the same numerical position as the second one. The station will be tuned out. Then the extra capacity (CT) is added until the station comes in again, as loudly as before.

Polarities of Dynamic Tuners

The foregoing presupposes that the Bernard tuners are correctly connected, that is, the dynamic coil is in full aiding position in respect to the stator coil when the condenser capacity is maximum, rotor plates fully enmeshed. If the dynamic connections are reversed the dial readings are adversely affected—the lowest receivable wavelength comes in at entirely too high a reading and the highest broadcast wavelength, 545 meters, can not be tuned in at all. With the wrong method it is sometimes just possible to tune in 526 meters, while 200 meters comes in around 40. This is obviously wrong. Reverse the connections of the dynamic coil, putting that end which went to the stator coil now to the tuning condenser, and the other end to the stator coil, or simply turn the moving coil, alone, around 180 degrees.

N THE HB COMPACT

Highest Efficiency from Battery Model

Bernard

The dial settings just given refer to the second tuned circuit. Unfortunately the first and second tuned circuits can not be directly compared for correct polarities of the dynamic coil, unless the equalizing capacity is first properly added to the antenna circuit. You do not know theoretically just what is the correct capacity to add, so the procedure naturally is to get the second tuned circuit working right, by the method previously outlined, so that 200 meters comes in, say, at 15 or less on the dial, and 526 meters at 85 to 90. Then put some capacity, not less than 80 mfd., across the other or first tuned circuit, and see that the dynamic coil is correctly connected there, by obtaining approximately the same dial readings here as in the second circuit. At least you know one easy solution: the whole wavelength range was tuned in with the second circuit, as well as with the first, before the equalizing capacity was added, and now that it has been added, the dynamic coil must be so connected that the whole band of frequencies still will be tuned in.

Pointer on Volume Control

The rheostat R5, working as a volume control, should be effective as such if its maximum resistance is 50, 75 or 100 ohms, but small values must not be used. Because the amplification at radio frequencies is so high, in some locations where strong fields exist about the antenna for particular stations' waves, the volume control will not perform all that is expected of it, although on weaker signals it behaves excellently, therefore put in series with the positive filament leg of the 222 tube, and only that tube, a resistor of about one-quarter the resistance of the rheostat.

If the 45-volt lead to the screen grid of either 222 tube seems to have no effect, whether connected or not, C3 likely is shorted.

Another possibility for shorting is in the flexible couplers or links used to connect the coil shafts physically with the shafts of the condensers that are mounted behind the coils. In some makes of links if the front and rear collars are pressed until they strike, and if the coil winding is grounded on the front of a metal cabinet, the short results. Hence if a metal cabinet is used with coils that have their shafts conductively coupled to the winding as well as to the front panel, not only insulate the coils from the front panel, but also see that the link's collars do not touch. This point about coils refers particularly to those manufactured by the National Company, of Malden, Mass., which are de luxe models.

The coils made by the Screen Grid Coil Company, which cost less, have their shafts independent of any connection to the winding, so the caution about the flexible couplers and insulating the coil shaft from the front panel do not hold as to them.

Insulate the Rheostat

The rheostat should be insulated from the front panel in every instance, as otherwise one side of it goes to grounded A minus (the potential of the front panel which arises if a metal subpanel is used). There are two ways to insulate: use a soft rubber collar that grips the panel hole, because the rubber is grooved about the circumference; or use two hard rubber, fiber or bakelite insulators, one front, one back of the metal front panel at the hole, and tighten the lock-nut of the rheostat against these when the rheostat projection is free of contact with the front panel. This is practical, because in the specified steel cabinets the front which is a part of them has oversized holes.

If an insulation front panel and an insulation subpanel are used, none of these tuning condenser-coil-rheostat shorting precautions is necessary.

If flat type dials of the "full-vision" type are used, then some indicating device is necessary. This may be a dial pointer, inserted at the proper place through a hole drilled in the front panel. Using a small drill, say, for No. 6 machine screw, the usual size in radio, it is not difficult to drill through the steel. The drill can not be turned at regular speed, but soon has to be gripped and turned about half a revolution at a time, with thumb at the axis, until piercing is completed. A nut will affix the dial pointer.

However, sufficient indication will be provided if the steel front panel is carefully marked at the indicating point, the dial removed and the very smallest drill you have being user to register this point. Then replace the dial.

Cures for Motorboating

Turning to the audio circuit, which is resistance coupled, the values of the resistors, as specified in the list of parts and designated in the diagram, are those that worked out very well. Nevertheless in some instances motorboating may result, due principally to the use of B batteries that have outlived their usefulness and hence have built up a very high resistance that acts as a coupling resistor between circuits, or to the use of a B eliminator that has motorboating characteristics arising largely from being under-capacitated and having altogether too high resistance in the filter chokes. The remedy as applied to the present circuit is to reduce the value of R3 to 50,000 ohms, which will reduce the amplification at audio frequencies, but this the circuit can stand, and besides the remedy is necessary where motorboating arises.

If the detector, which is a power detector in this circuit because worked on the negative grid bias principle, has too high a bias it will be an amplifier rather than a detector, and the extremely high amplification will tend toward motorboating. The signal will be weak, besides blurred or staccato. Therefore reduce the bias.

Loudest signals will be obtained, without motorboating, when the grid return of the detector is placed at the negative filament of that tube, but the grid will swing positive under that condition, grid current will flow, selectivity will be reduced and quality impaired. So the goal is really not the loudest signals as a test of the detector, but the best detection around 3 volts negative. If necessary this bias may be cut in half, but the tube should not be worked at less than 1.5 volts negative bias. Note, too, where C plus is connected, at the joint of R6.

If bias troubles you at the detector, try a lower plate voltage.

Signals that get through the detector but not through the audio amplifier impel you to search out a short. Test R1, R2, R3, C4 and C5, and also the loudspeaker winding.

General Advice

As for general advice, watch out for:

(1) poor tubes; (2) leadin not connected to aerial; (3) contact failures; (4) shorted wiring; (5) wrong voltages or no voltage; (6) condenser plates touching.

Poor tubes can be readily determined by substituting tubes known to be good because of their performance in another receiver or in this one. If you suspect the 222 tube in the RF socket, *disconnect ground* and connect aerial to the plate post of the RF socket. If signals now come through, the first tube or the first tuned circuit was at fault.

The leadin should be conductively connected to the aerial. The usual advice is to solder this connection, but the aerial is on the roof and there is often no way of heating a soldering iron there, or of making it hot enough to operate, so tin foil may be wrapped around the cleaned joint, and then the splicing is taped.

Contact failures may arise at the sockets, or at wiring joints, batteries or speaker, particularly A batteries where the terminals are corroded, the corrosion being more prominent at the positive post.

Insulation on the Wire

Shorted wiring may arise because of poor insulation on wire used, especially where the wire insulation has to touch the subpanel, as in numerous instances in the HB Compact. Thus if the lead carries any direct current other than that through grounded A minus, then poor insulation may result in spasmodic or permanent shorting.

Wrong voltages are frequent causes of trouble. The voltages are marked on the diagram. Follow these. Where too much amplification or some instability arises, the screen grid voltage of 45, designated for the G posts of the two screen grid tubes, may be lowered, but it will be found that at least 22½ volts usually are necessary.

The C bias may be reversed, that is, positive biases obtain.

Lack of voltage will be due to depleted batteries, shorts or failure of connections.

245 ABC SUPPLY

Combination May be Compact

By Herber

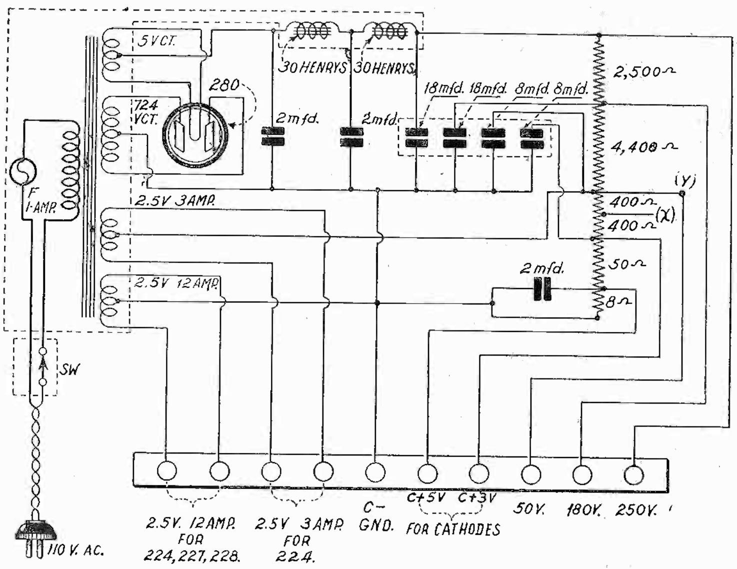


FIG. 1

DESIGN OF AN ABC SUPPLY FOR 245 OUTPUT IN SINGLE OR PUSH-PULL FORMATION, WHERE THE OTHER TUBES ARE OF THE HEATER TYPE, 224, 227 OR 228. THE LOW CATHODE VOLTAGE IS C+.5.

THE output circuit of AC receivers is becoming standardized, the 245 tube being used in single or push-pull formation, with a tendency toward predominance of push-pull. This makes possible the construction of a B supply that will furnish also the required filament and biasing voltages, since the remainder of the tubes require 2.5 volts on the heaters and a 12-ampere winding takes care of this.

A visualization of such a B supply is shown in Fig. 1. If a single 245 output tube is used, as is common if the audio circuit is resistance-coupled, the 50-volt lead is brought out as shown, from point Y. If the output is 245 tubes in push-pull, then all the connections that go to Y in the diagram are omitted, and instead they go to X, which is approximately halfway between Y and the negative lead. The reason for using less resistance is the increased plate current occasioned by the second 245 tube.

An Exclusive Opportunity

Constructors will want to build an ABC supply like this because it permits them to adopt popular and efficient screen grid circuits, and also because there is no factory-made ABC supply that fulfills the purpose.

The circuit is a standard one. It uses filter and bypass condensers of adequate capacity for the intended purposes, and circuits like it, with somewhat different capacities, were published in the August 10, 17 and 31 issues of RADIO WORLD, and these should be consulted at least for the extensive theoretical presentations.

The only unusual voltage is a bias of about .5 volts negative, which may be used if a space charge detector is selected for the tuner. This is a type of detector fraught with great possibilities, where the plate load is resistive, but the voltages are critical. Once established correctly, they permit enormous volume from the detector, hence more than an abundance for the loudspeaker. The cap or inner grid of the screen grid detector is connected to the 50-volt lead, the G post or outer grid goes to the tuning coil, while the cathode, heater and plate are connected in standard fashion, the plate voltage being 180 volts when the plate resistor is .05 meg, (50,000 ohms.) If heavy current (more than 80 ma.) flows, then the 8-ohm section should have a 20-ohm resistance across it.

The B supply uses a 280 rectifier tube, which furnishes sufficient current to work even an abnormally large receiver.

However, if push-pull is used, the total number of tubes is limited to seven, for 110 milliamperes total plate current and bleeder current. The bleeder is that current which flows through the voltage divider independent of plate current drain, and is the same throughout the entire resistance across the output, a little over 30 ma. Biasing of the output stage is accomplished in the B supply, and as the heaters of the other tubes are independent of the filament of the power tube or tubes, the bias voltage becomes available for positive voltage of about 50 volts, commonly used for the G posts of screen grid tubes and for detector plate voltage. If negative grid bias (power) detection is used, the 180 volt post is used for the detector plate, but for leaky-condenser rectification the 50 volt post is connected instead.

The 8 ohm section of the voltage divider is to provide negative bias for a space charge detector, but if this type of detection is not used, the post need not be included on the output strip, nor of course need the 2 mfd, condenser across this 8 ohm section be included.

Compactness is attained by using a 245 type power supply with choke coils of 30 henries each built in, and affording on the transformer side all the necessary voltages (Polo 245 supply.) The maximum output voltage will be 300 volts DC when 80 milliamperes are flowing through that part of the voltage divider which carries the heaviest current. In general this is the biasing section for the last tube, but of course that section of the same resistor that carries the plate current of the other tubes carries the power tube plate current as well. It must not be assumed that 80 ma. flow through the entire voltage divider.

As more current is drawn the voltage declines. This is known as the regulation. Even with push-pull the voltage will be sufficiently high. The output tubes normally get about 250 plate volts, the other 50 volts being used for biasing the power tube or tubes. Smaller bias is provided for the RF, detector and preliminary audio tubes because their cathodes are connected nearer to the negative of the B supply. For instance, with 10 milliamperes drawn by these tubes, the negative bias would be the product of the resistance, 58 ohms, and the current (30 ma bleeder, 32 ma for single 245, and 10 ma for the other plates) or 58 x .072=4.76 volts. The positive output post is marked C+3 volts. As the voltage will be 3 volts or more and is not critical, one may use what bias voltage obtains. The larger current through the 58 ohm section provides the higher

Right or

[Herewith are ten questions. They are propounded from articles published in last week's issue, September 7th. If you read that issue carefully, then you should be able to answer all ten questions accurately. Read this week's issue from cover to cover and and you will know the answers to next week's questions even before the questions are put.—Editor.]

QUESTIONS

(1)—Short wave stations from foreign countries cannot be received without using a multi-tube amplifier because tubes don't amplify well at high radio frequencies.

(2)—A good outdoor antenna is one of the essential conditions for receiving short wave stations from foreign countries.

(3)—A sensitive milliammeter can be used for measuring a wide range of either current or voltage by employing suitable shunt or series resistors.

(4)—The more sensitive the milliammeter the wider the range of currents that can be measured and the better the voltmeter.

(5)—The best place to connect the phonograph amplifier is in the socket of the detector tube.

(6)—If good quality is to be obtained from a condenser type microphone, the resistance in series across which the signal voltage is developed must be exceedingly high and the leakage through the insulation must be as low as possible.

(7)—A carbon button microphone does not require a polarizing battery.

(8)—A high mu tube of the heater type cannot be made successfully because the heater voltage gets into the signal and causes hum.

(9)—All thoriated filament tubes can be reactivated by "flashing" and "burning" the filaments.

(10—The emission from a filament is the total current in milliamperes that flows between the filament and the grid and plate combined.

ANSWERS

(1)—Wrong. It is seldom required to use more than four

WITH AUDIO CIRCUITS

Effected for Power Amplifier

E. Hayden

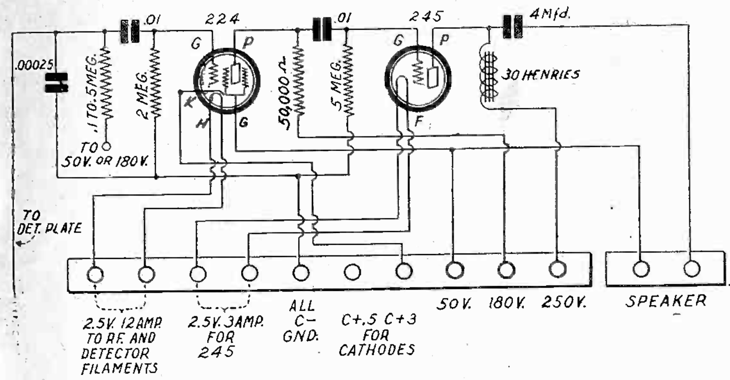


FIG. 2

A RESISTANCE COUPLED TWO-STAGE AUDIO AMPLIFIER TO BE USED IN CONJUNCTION WITH THE ABC SUPPLY, FOR SINGLE 245 OUTPUT. IF A DYNAMIC SPEAKER IS USED THE 4 MFD. CONDENSER AND 30 HENRY CHOKE CONSTITUTING THE OUTPUT FILTER MAY BE OMITTED. THE 4 MFD., IF INCLUDED, SHOULD BE OF 500 RMS. VOLTS ACTUAL WORKING VOLTAGE.

bias, but this is in a safe direction, since the higher biases will be suitable where larger output volume without distortion is required, as in push-pull, and where higher current is drawn.

If a power amplifier is to be constructed, Figs, 1 and 2 may be united. The audio channel is resistance-coupled and the output tube is a 245. It is not only customary but compulsory to use a single-sided output with such an audio circuit, since there is no known method of using resistance-coupled push-pull without one side of the circuit being dead, that is, the whole push-pull idea being killed. Nor is it necessary to use push-pull with this circuit, since the power handling capacity of a single 245 not only is great enough for the circuit but also is ample for any home.

For reasons already explained the detector plate is not shown connected, but either the 50 volt or 180 volt connection will be used. The "empty" detector plate lead, of course, goes to the P post of the detector socket. This socket will be in the receiver, not in the audio amplifier.

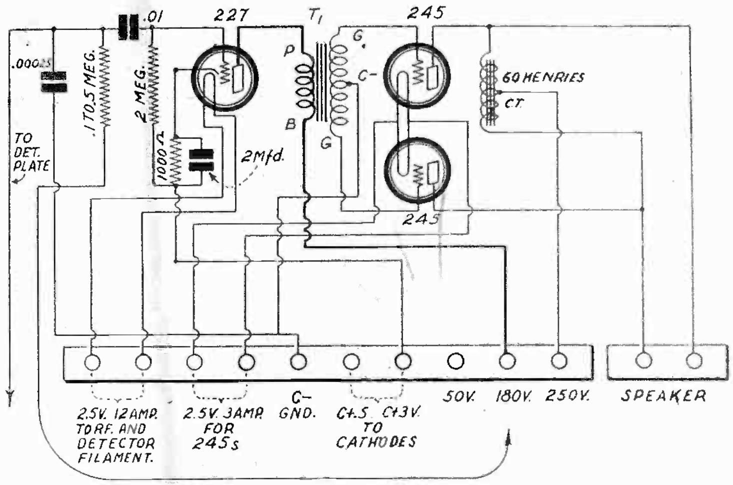


FIG. 3.

THE OUTPUT CIRCUIT HERE IS TWO 245 TUBES IN PUSH-PULL. THE CENTER-TAPPED 60 HENRY OUTPUT IMPEDANCE IS TO BE INCLUDED NO MATTER WHAT TYPE OF SPEAKER IS USED, BECAUSE EVEN THE DYNAMIC SPEAKERS, ALL OF WHICH HAVE OUTPUT TRANSFORMERS BUILT IN, DO NOT HAVE SUITABLE CONNECTIONS TO THESE OUTPUT TRANSFORMERS FOR PUSH-PULL. THE CENTER-TAPPED IMPEDANCE TAKES CARE OF THIS.

227 in This First AF Stage

If a push-pull output is desired, then the detector stage remains resistance-coupled, but the first AF stage must be transformer-coupled, and should have a 227 tube, as shown. The bias on the first audio tube, with 180 plate volts applied, should be heightened above the 6 volts otherwise obtained, hence the 1,000 ohm resistor is added, from cathode of the 227 to C plus "3," and a 2 mfd. condenser put across this resistor. This condenser may be of low voltage test, 100 volts, 200 volts or so, DC working voltage.

Fig. 3 shows the audio circuit for push-pull, with the output center-tapped impedance. This is a good form of output for push-pull, and serves either a dynamic or a magnetic speaker. The impedance of the speaker virtually determines the impedance presented to the output circuit, hence the double utility of the center-tapped coil.

The choke-condenser output in the single-sided circuit is necessary only if a magnetic or inductor speaker is used, for if a dynamic speaker is attached, it has its own output transformer built in, and the 4 mfd. condenser and the 30-henry choke coil therefore may be omitted from Fig. 2.

The ABC supply may be built as a unit, or ABC supply and audio amplifier (either one) may be incorporated in the same unit. Metal containers may be used for this purpose. Something about these containers will be published next week, issue of September 21.

The ABC supply and both audio amplifiers have been carefully tested and found excellent. Those building the device in any of its three forms will find they have something really worth while, the only precaution being that for best tone quality where push-pull is used, a fine push-pull input transformer be used, while the output choke in either instance should be well able to handle the current without saturation of the core.

Wrong?

tubes for receiving a long distance station on short waves. While tubes do not amplify well on short waves the signals on short waves travel farther and regeneration in a receiver is more effective on these waves than on broadcast waves.

(2)—Right. A good outdoor antenna is essential for receiving long distance stations on any frequency.

(3)—Right. For measuring current it is only necessary to shunt the meter with a suitable resistor and for measuring voltages it is only necessary to put a high resistance of suitable value in series.

(4)—Right. The lower limit of a range is determined only by the sensitivity of the meter, the upper by the value of the shunt. The more sensitive a meter the less current it takes, and hence the better is the voltmeter made with it.

(5)—Wrong. This is the worst place. The pick-up unit should be connected either in the grid circuit or in series with a transformer primary. It should never be connected so that a high voltage source also is in series with it.

(6)—Right. If there is much leakage, whether through the insulation or the load resistance, the more quickly does the minute condenser discharge and the lower will the response to low notes be.

(7)—Wrong. A carbon button microphone will not work unless there is a DC voltage in the circuit.

(8)—Wrong. A high mu tube of this type was discussed in the Aug. 31 and Sept. 7 issues of Radio World. It has exceptional characteristics.

(9)—Wrong. Many tubes of this type are so badly damaged that they cannot be reactivated. But the thoriated filament tube is the only kind that can be reactivated.

(10)—Right. When measuring the emission current the grid is tied to the plate so that it will not exert any retarding force on the electrons. The current is measured at the operating filament voltage and at a plate-grid voltage of a moderate value.

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. The reply is mailed to the member. Join now!

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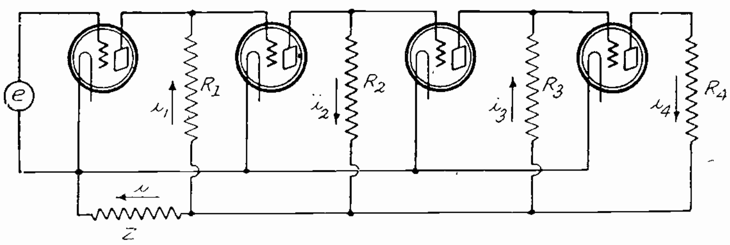

FIG. 783
WHAT IS MEANT BY "COMMON IMPEDANCE" IS SHOWN BY Z. THE PHASE RELATIONSHIP WITH THE SEPARATE STAGES IS INDICATED BY ARROWS.

"COMMON impedance," "phase relationships" and "stray coupling" confuse me. Please explain.— T. J. O'B.

The term "common impedance" refers to an impedance common to two or more circuits. It is a term used mostly in analysis of audio circuits where motorboating is discussed. The current flowing through the choke coils of a B supply, for instance, makes the impedance of the chokes common to the receiver tubes' plate current. Thus impedance is Z in Fig. 783. "Phase relationships" expresses the phase of the voltage in respect to the phase of the current. Successive tube stages reverse the phase. "Stray coupling" is any accidental or unintended coupling.

* * *

Types of Regenerators

THE three famous triplets of radio—resistance, inductance and capacity—are used in regenerative circuits. Which method is best?—D. S.

All three methods have advantages. Resistance is used to control regeneration by connecting a fixed tickler coil, with an adjustable resistor across it, about 3,000 to 5,000 ohms maximum. The plate voltage is thus kept constant, as the resistor acts on the radio frequency voltage only. Another method, not quite so good, is to have the resistor in series. This changes the plate voltage, hence the detecting efficiency is altered and the resistor becomes a pronounced volume control, whereas it is better to have a separate volume control, so that the circuit may be tuned closely, with the full aid of regeneration, and the volume then levelled down to the desired amount. The strictly inductive method is to connect a rotatable tickler coil in the plate circuit. This is more economical and works well. The capacity method consists of feedback back through a midget variable condenser, connected from detector plate to the a point on the grid coil of that tube or the plate coil of the preceding tube, depending on the whether the coil connections reverse the phase. If no regeneration results, reverse the connections to the winding to which the regeneration condenser is connected. The capacity method herein described is called shunt feed and constitutes the circuit a Hartley oscillator. Resistance-controlled regeneration, parallel method, is used in the National Thrill Box, a screen grid short-wave set, and works excellently. Strictly inductive regeneration is a feature of the Screen Grid Diamond of the Air. The capacity feedback method is used in the screen Grid Universal. The capacity method perhaps affords longer life of the regeneration control, as a condenser may be turned many more revolutions than a resistor arm or a moving, tickler coil, without showing any signs of wear. This is a small point, however, since the two other methods, using good parts, may be regarded as reliable for five years.

* * *

When Is B Minus C Minus?

WHAT is the difference between C minus and B minus in a B supply?—H. S. D.

In a B supply the rectifier tube filament always is positive and the plate always is negative. One side of the filament or the center-tap may be used to take off the positive lead. The plate of a single-wave rectifier tube is used directly as negative, but in a full-wave rectifier the center-tap of the winding that has its extreme terminals going to plates is used for negative. Therefore the negative lead and the maximum positive lead always are just that, and what relative values may be assigned to them depends on the circuit and the viewpoint. Take a power tube with filament heated by AC. The midtap is positive and is connected to some positive voltage in respect to the negative B lead. For a 245 tube with 250 volts on the plate this connection would be to plus 50 volts for the midtap. Hence a grid return made to negative B would provide a negative value of 50 volts. The negative of the B supply is still the negative of the B supply. But as voltages applied to tubes are reckoned from the negative filament for battery-heated tubes and from the midtap of a filament winding for AC filament tubes, the negative of the B supply is 50 volts negative in respect to the midtap, and the negative may be called C minus 50 volts for that tube. In such an instance the midtap would be referred to as B minus only as an habitual inaccuracy derived from use of batteries. Filament connection would be a better term than B minus, since the minus of the B supply has been used as C minus, and that should prohibit any further use of the expression B minus to avoid confusion.

* * *

Clockwise and Counter-clockwise Dials

PLEASE explain the difference between clockwise and counter-clockwise dials, and the types of tuning condensers with which each dial is to be used.—S. D. E.

Imagine a flat type "full-vision" dial before you, with numbers on it graduated from 0 to 100, the extreme readings being at left and right. If 0 is at left and 100 at right the dial is counter-clockwise, that is, to attain higher readings the dial has to be turned to the left, the direction counter to the one taken by the hands of a clock. Therefore a counter-clockwise dial is to be used with a tuning condenser that affords higher capacity readings when the rotor shaft is turned to the left. The object is simply to match the direction of capacity increase with a suitable dial, to afford higher numerical readings for higher capacity settings. In a counter-clockwise dial the numbers themselves increase to the right, e. g., 0 to 100, by mere examination of the scale, but the dial has to be turned in the opposite direction (i. e., to the left) to obtain the higher readings by manipulation. A clockwise dial is one reading from 100 to 0, left to right, and has to be turned to the right to afford higher numerical readings, the condenser capacity increasing when the rotor is turned to the right. With a drum dial the same situation exists, but except that the direction of scale rotation is at right angles to that of the knob. The knob still has to be turned to the right for higher numerical readings for a clockwise dial, and to the left for higher readings for a counter-clockwise type. Condensers with shafts reversible or protruding front and back make a standard type of clockwise drum dial feasible, since the condenser need be only physically reversed (shaft at opposite end engaged) if the dial acts at cross purposes to the scale.

* * *

Omission of Filament Resistors

CAN a 3 volt radio frequency amplifying tube and a 5 volt detector tube be heated from No. 6 dry cells without the use of rheostats to correct the battery voltages to the required filament voltages?—D. A.

Yes. Three No. 6 dry cells may be connected in series. They give a total maximum of 4.5 volts, and this entirely is applied to the filament of the detector tube. Good detection will be obtained, despite the ½ volt difference between rated voltage and applied voltage, indeed some of the 5 volt tubes detect better at 4½ volts. The same negative terminal connected to the detector tube may be joined to negative filament of the RF tube, while the negative of the third cells in the series is connected to the positive filament of the RF tube. This puts 3 volts on the RF valve. Instead of making the negative lead common, the positive lead may be made common to both filaments, the full 4.5 volts applied to the detector, and the 3 volts being supplied to the RF tube by making positive of the first cell the negative filament connection of the RF tube. This enables a 1.5 volt negative bias being applied to the RF tube by connecting the grid return of that tube to negative filament of the detector tube. In either instance three cells are used for the detector tube and only two of them for the other tube. Each cell has a voltage of 1.5 volts.

* * *

Where Should B Minus Go!

IN a battery-operated set, should B minus be connected to A minus or to A plus?—D. W.

It is preferable to connect B minus to A minus, because it is customary to ground A minus, and the point to which ground is connected are much more numerous. If, due to a carelessly loose lead or accidental contact, a high B voltage is applied to one of these numerous points, no harm can be done to the filaments, because only the B batteries are shorted. If A plus were connected to B minus, then such accidental contact to A minus at one of its numerous points in the receiver would apply the high B voltage to the filaments of all the tubes, and burn them out. When B minus is connected to A minus the applied B voltage is the voltage of the B battery less the drop in voltage in the filament resistor. When B minus is connected to A plus, the B voltage applied to any tube is the voltage of the B battery plus the voltage across the filament of the tube. This extra B voltage is too trivial to deserve capitalization at the highly enhanced risk of ruining all the tubes in a receiver.

* * *

Leeway in Filter Condensers

ARE filter condensers critical as to excess voltage?—R. S. D.

That depends on what you regard as critical, and how excessive the voltage is. For instance, a filter condenser rated at 550 volts root mean square, or 800 volts DC, both continuous working voltages, was put under a strain of 1,500 volts, and punctured only after enduring this high burden for twenty minutes. If your question is prompted by mere curiosity the foregoing gives you a good picture of the situation. If you desire guidance in the practical use of filter condensers, all should be worked at least 20 per cent. under their continuous working ratings.

* * *

Negative Grid, Current Flows

CAN grid current flow, although the grid is negative in respect to the negative filament?—F. A. W.

Yes, particularly where the negative bias is small and the impressed signal value is comparatively high.

* * *

Tube's Figure of Merit

IS it practical to use the mutual conductance as the basis of comparison of different types of tubes?—H. G.

The mutual conductance is often used as a handy basis of comparison, and is called the figure of merit of the tube, but this method of comparison is not quite satisfactory, and is used only because no better substitute has been popularized. The mutual conductance is ratio of the amplification factor to the plate resistance. Therefore tubes not used as voltage amplifiers, but for their power-handling capacity, e. g., power tubes, have a higher mutual conductance than other tubes. If you were to compare different manufacturers' products, using the same type tube, the mutual conductance would be an excellent basis, and it would be a good way to compare tubes of different types but intended for the same purpose.

* * *

Coil Winding Data

WINDING data for .0005 mfd. and .00035 mfd. condensers, on 2½" forms, are required.—H. F. S.

For the antenna coil wind 14 turns of No. 24 silk covered wire for the aerial winding, leave ¼" space, and wind 52 turns for the secondary, using the same kind of wire, for .0005 mfd. For interstage coupling, where general purpose tubes are used, repeat these directions for the coils. If a screen grid tube is to be used, the untuned winding in the plate circuit should consist of at least twice as many turns as otherwise (28 to 36). If the screen grid tube's plate circuit is to be tuned, then the 52-turn coil is the primary, while a coil with larger inductance is the secondary. This secondary, used as a pick-up coil, may be wound on a 2⅛" diameter tubing. Put on 60 turns. If the plate circuit is tuned the entire broadcast winding frequency range will not be tuned in unless Bernard tuners are employed. See directions in the September 7th issue. For .00035 coils use a 65 turn secondary, the other windings being the same, except the pick-up coil has 100 turns.

* * *

Too Much Drain

IS a 400 ohm potentiometer used as a volume control across 90 volts of B battery all right?—D. Z.

No. Use a potentiometer of much higher resistance value, 25,000 ohms or more, 500,000 ohms being preferable. The 400 ohm potentiometer draws 22½ milliamperes, a large drain, especially when considered as additional to the tube drain on the B batteries.

August "Proceedings"

The August "Proceedings of the Institute of Radio Engineers," besides containing articles noted in a previous issue of RADIO WORLD embodies works by other noted men.

L. E. Whittemore, American Telephone & Telegraph Company, New York, contributes a discussion on "Some Principles of Broadcast Frequency Allocation," and John V. L. Hogan, Consulting Radio Engineer, New York, follows with "A Study of Heterodyne Interference." Both of these papers are essentially on the same subject but differ considerably in the point of view and the method of presentation.

Arthur Batcheller, United States Supervisor of Radio, Second Radio District, New York, N. Y., gives "An Outline of the Radio Inspection Service," the purpose of which is to present a brief history of the Radio Inspection Service of the Department of Commerce from its inception, July 1, 1911, up to the present day, together with an outline of the scope and general nature of the work performed by this important agency of the Government.

S. W. Edwards and J. E. Brown, Radio Division, Department of Commerce, Detroit, Mich., discuss "The Problems Centering About the Measurement of Field Intensity." The paper deals with field work done by the engineers of the department, and shows field intensity contour maps around two broadcasting stations, one a 1,000-watt station operating on 720 kilocycles and the other a 5,000-watt station operating on 640 kilocycles.

"The Radio Engineer's Responsibility in Coping With Man-Made Interference" is the title of a paper contributed by Edgar H. Felix, Radio Consultant, National Electrical Manufacturers' Association, New York. Every radio owner will find this paper interesting and profitable, as it discusses man-made interference which he himself or his neighbor may be responsible for and which he can correct to the general improvement of radio reception.

Along the same line is a paper by M. D. Hooven, Jr., Public Service Electric & Gas Company, Newark, N. J., entitled "Radio Coordination." This paper should be read by every service man who is called on to trace down interference to radio reception.

"United States Radio Broadcasting Development," by Robert H. Marriott, Consulting Engineer, Federal Radio Commission, Washington, D. C., is not merely an article on the subject indicated in the title; it is a veritable course in the history of broadcasting in the United States. Every phase of the subject is treated briefly and in as nearly non-technical language as possible. Part I of the paper gives in detail the development of radio broadcasting in the United States from 1907 to 1928, inclusive; Part II deals with the development of a radio broadcast from the studio to the listener. In Part III the characteristics and trends of these developments are used for the purpose of pointing out possible future developments in radio broadcasting.

Fig. 1 in the paper is a chart showing graphically the development of every phase of broadcasting. Fig. 2 is a schematic representation of what occurs between the broadcaster and the listener, beginning with the sound producer and ending with the sound absorber, the listener.

A very valuable feature of this paper is a bibliography containing seventy-four references to original sources and discussions.

FISCAL YEAR'S SALES PUT AT $510,000,000

Radio sales totaling $91,000,000 were indicated for the months of April, May and June, says the Radio Division of the National Electrical Manufacturers Association.

In the July 1st tabulation of stocks in hand of radio dealers, from which this total was estimated, the Department of Commerce queried 38,766 radio dealers, receiving replies from 6,031, or 15.6 percent, whose business for the second quarter was $14,172,740. This compares with sales of $25,539,235, representing a 19.4 percent return for the preceding quarter.

$510,000,000 Year

Estimates of total radio sales for the so-called radio year from June 30th, 1928 to June 30th, 1929, place the figure at approximately $510,000,000. The average total volume of business for each dealer during this radio year was $14,528. More than 3,108,000 sets, both AC and battery operated, were sold during the same period. Only 13 percent of this total was battery-operated.

The regional analysis included in the July 1st quarterly survey places Illinois first, New York second, and California third in volume of sales.

Gets Out Somehow or Other

An interesting sidelight on radio merchandising is contained in the diverse channels by which radio equipment makes its way to the consumer. Reports to the Department show sales by firms and individuals giving their principal lines of business as that of poultry raiser, harness shop, funeral director, court reporter, baby chick hatchery, pool room, optometrists, insecticide dealer, patent medicine dealer, etc.

Foundation Formed To Make Six Awards

The Freed-Eisemann Radio Corporation announced the Joseph D. R. Freed Foundation to bestow six different annual awards for broadcasting excellence.

The first award will be made to the broadcasting station which presents the outstanding program of each fiscal year, figured from September 1st. The second award will be made to the outstanding individual radio broadcaster each year. The third award will be made to the individual creating the outstanding program on the air. The fourth award will be made to the radio station which, during each year, makes the greatest technical advance in handling programs. The fifth award will be made to the radio station which, through its programs, shall best represent the educational value and power of broadcasting in raising the American standard of morals, taste and manners. The sixth award is to be made to the advertising agency or corporation presenting the finest advertising programs on the air each year.

ELECTRAD'S NEW FOLDER

Electrad, Inc., 175 Varick Street, New York City, has issued a new folder on volume control resistors, with diagrams. In writing for the booklet, entitled "The Super-Tonatrol," mention RADIO WORLD.

Chicago Out to Be the Radio Capital

What is known as "friendly rivalry" has developed between Chicago and New York to be the broadcasting capital of America by January 1st, 1931.

New York City is admittedly first now, and holds a considerable lead, as M. H. Aylesworth, president of the National Broadcasting Company, told a Senatorial committee a few months ago. Chicago is now growing fast in broadcast importance, he now says.

NEW TELEVISION WAVE IS ASKED

The Radio Manufacturers Association announced that a separate air channel for a synchronizing signal for television experiments may be requested of the Federal Radio Commission. The RMA Television Committee, D. E. Replogle, chairman, has recommended that the Commission consider the advisability of assigning a separate channel.

Standard recommendations relating to scanning are being retained for the present. The RMA recommends that scanning at the receiving end be from left to right, and from top to bottom in uninterrupted sequence, looking directly at the object.

Standard practices for television experimenters, are being recommended by the committee. Assuming that the first successful television probably will be from talking picture films, it is recommended that experimenters use discs to give 48 by 57½ picture elements, at speeds of 15, 20 and 24 frames per second, and also 60 by 72 at 20 and 24 frames per second. Most talking pictures are projected at 24 frames per second, as a slower rate would not bring as satisfactory results, although there is admitted difficulty in obtaining the higher speed with standard motors.

Television engineers are of the opinion that it is too early to adopt fixed standards for disc speed or hole arrangement of television transmitters, and that it is too early to impose rigid standards on the television art to which it is hoped amateurs will make valuable contributions.

Ware Trying to Sell Shield Patent Rights

Paul Ware, of the Ware Radio Inc., says the corporation has obtained control of his patent for the use of selective shields to prevent so-called "back door" reception. The patent, applied for on June 30th, 1922, contains twenty-two claims. Ware is trying to get set manufactures to take out a license on a royalty basis.

WORTH THINKING OVER

Look out for the stock bandits. Perhaps they'll bid a low price on your RCA stock, giving as a reason the recent decision against RCA in favor of the Dubilier Corporation. But don't forget that if RCA stock isn't worth much, no other radio stock is worth a nickle a bundle. RCA still owns, controls and has all tied up nearly every basic radio patent of real importance. If you don't believe it, count how many reputable firms make unlicensed receivers.

SUPERVISORS ACT TO ASSIST DX RECEPTION

An investigation of methods of improving the reception of distant stations has been made by Federal Supervisors, who are under the Department of Commerce. This investigation had to do with the general behavior of stations in respect to the radio law, and the effect of that behavior upon reception.

It has been found that quite a number of stations do not adhere strictly to their assigned frequencies. The channel separation is 10,000 cycles (10 kc.), fixed by the Federal Radio Commission, which permits 5,000 cycles each side of the carrier frequency. A 500-cycle excess is permitted.

Interest in DX Revived

Often stations outside the large centers are offenders in straying off their assigned frequencies, the result being that reception of distant stations even those assigned to cleared channels, is greatly impaired, sometimes even prevented. Steps are being taken to correct this situation, especially as the interest in the reception of distant stations is now becoming large again, due to the advent of the new season and also to the fact that new receivers are more sensitive and selective, and again make possible the reception of signals from broadcasting stations over extremely long distances.

In the New York area Arthur Batcheller, supervisor, kept tabs on local and distant stations three times a week for several weeks, operating from the Sub-Treasury Building. Once again the fact was brought home that station announcers are neglectful of their obligation to announce call letters every fifteen minutes, unless so doing interferes with a continuity. Such long waits had to be endured to ascertain the call of an offending station that Mr. Batcheller made careful note of the facts for report to his superiors.

Identity Often Not Obtained

Often it was impossible to identify the station at all, as the listener could not wait all night for the information. About fifty stations a night are gauged as to their frequency steadiness and accuracy.

Two stations were found slightly off their assigned frequency in the New York Metropolitan District. The violators were 600 and 700 cycles off, respectively.

"If the supervisors could get the broadcasting station on their waves and keep them there," said Mr. Batcheller, "distant station reception would be greatly improved."

Hague Delegates

Washington.

The following United States delegates will represent private radio interests at the Hague conference on international radio, September 18th.

Colonel Samuel Reber—RCA.
Dr. John Nathansohn, Universal Wireless.
H. H. Buttner, Telephone Company.
R. Y. Tuel, Mackay Company.
L. A. Briggs, RCA Communications.
Charles J. Pannill, Radio Marine.
Lloyd Espenschied and William Wilson, Telephone Company.
William E. Beakes, Tropical Radio.
J. W. Swanson, Southern Radio.
Ralph M. Heintz and Edgar M. Wilson, Dollar Steamship Company.

"TELE-TALKIES" BY BAIRD PLAN DEMONSTRATED

Simultaneous entertainment for both the eye and the ear was demonstrated here recently in the studio and laboratory of the Baird Television Corporation, through the transmission of clear television images and the voice of the televised person over a wire circuit.

The frequency band employed was such, according to the designers of the system, that talking images can be transmitted with sucess over any broadcast station.

During the demonstration the voice came through clearly and the visual signals were clear enough to read newspaper headlines a quarter of an inch in height, or to identify objects such as photographs of a person and of a well-known automobile.

Captain Jarrard in Charge

The transmission took place over special wire line between the office of the corporation in the Paramount Building and the laboratory on 45th Street, and was under the direction of Captain W. J. Jarrard, representative of the Baird interests in America.

"What you have seen here today of our progress with images over wires, equivalent to '10-kilocycle' radio transmission," said Captain Jarrard, "is now to become a reality on the radio in England. I have been informed today by cablegram from London that the British Broadcasting, the British Postoffice and Baird have at last come to an agreement and experiments are to start immediately."

Uses a Film

"In the production of 'tele-talkies' Baird utilizes a film (like sound films in this country) and simply transmits the sound on one wave and the image on another. The importance of sending speech with vision is immensely accentuated where 'tele-talkies' is concerned. Owing to the fact that only the narrow waveband (10 kilocycles) can be used, both television and 'tele-talkies' are limited to somewhat restricted scenes, such as one or two persons speaking or singing. Such subjects, when seen only, without the accompanying sounds, have very little interest compared with a combination of vision and sound. The sound helps the vision and the vision helps the sound. The combination is infinitely superior to one or the other separately."

NEXT WEEK

THE BIG, BRISTLING **SHOW NUMBER** *of RADIO WORLD*

Dated Saturday, September 21st

Will contain a glamorous array of fascinating technical articles, up-to-the-minute news of the trade as revealed by latest show preparations, reports on big news events in the broadcasting and receiving fields, intimate details of newest parts and circuits, lists of broadcasting stations by frequencies and wavelengths, and by call letters as well, with a list of short-wave stations, too.

Besides there will be four big surprises! Get this wave for sure!

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at bottom may be used, or a post card or letter will do instead.

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature.

Name ....

Address ....

City or town ....

State ....

H. C. Ford, 413 16th St., Denver, Colo.
Oscar Ise, 1748 Collamer, East Cleveland, Ohio.
S. Forester, 13626 Indiana Ave., Riverdale, Ill.
Saul Surlovitch, 2225 60th St., Brooklyn, N. Y.
W. C. Harmon, 1308 Walnut St., Duncan, Ohio.
Stanley F. Komorowski, 2670 Briggs Ave., Bronx, N. Y.
Arthur Powell, P. O. Box 337, Suffolk, Va.
Geo. H. Keller, 1048 Lorena St., Los Angeles, Calif.
A. G. Tutmark, Alderwood Manor, Washington.
R. C. Dalbey, 721 Forest Ave., Ft. Dodge, Iowa.
T. D. Pinchong, San German, Oriente, Cuba.
John W. Vogan, Yuba City, California.
D. C. Maddux, 421 Rust St., San Angelo, Texas.
C. P. Mohr, 9 Coibron Rd., Staffordville, Conn.
Edward de Beauchamp, 506 North Grand, Okmulgee, Okla.
Joe Allee, 309 Delaware, Leavenworth, Kansas.
Sydney J. Toney, 753 N. 9th St., Richmond, Virginia.
Earl H. Shirk, 521 Maple St., Lebanon, Pennsylvania.

ASKS MITCHELL TO SUE 'TRUST'

Washington.

Oswald P. Schuette, former executive secretary of the Radio Protective Association, has started anew in his two-year effort to have the Department of Justice prosecute "the radio trust" as a monopoly. Attorney General Mitchell received the request. The latest contention is that the RCA group is collecting royalties but does not own or control all the patents, instead infringes some. The Lowell and Dunmore patents on hum elimination in AC receivers, recently decided in favor of the Dubilier Corporation, are cited.

In his letter Schuette said:

"For two years this radio trust—the patent pool of the Radio Corporation of America, the General Electric Company, the the Westinghouse Electric & Manufacturing Company, the United Fruit Company and the American Telephone & Telegraph Company—has been collecting millions of dollars in royalties from radio manufacturers on the pretense that its patents covered this process. Judge Morris' decision, therefor dramatizes our contention that the radio trust has been collecting these royalties, not on the merits of its patents, but on the coercive power of its illegal combination.

"For two years we have sought, in vain, from your Department, the protection of the anti-monopoly laws of the United States against the aggressions of this monopoly. We now renew that appeal and ask you, as the representative of the law-enforcing branch of the Government, to prosecute this illegal monopoly and to give to the independent radio industry the protection which Congress intended we should have when it passed these laws."

PORTABLE TYPE STATION RATED AS A NUISANCE

Washington.

Portable broadcasting stations should not be allowed in the existing set-up of broadcasting stations, because it is impossile for them to operate without causing interference and because the radio act contemplates a "fixed allocation," the Federal Radio Commission contends in a brief filed with the Court of Appeals of the Disrtict of Columbia.

The brief was in reply to the appeal of C. L. Carrell, of Chicago, against the decision of the Commission, entered on July 1st, 1928, abolishing portable stations, and denying Carrell's applications for renewal of the licenses of portable stations WKBG, WIBJ and WHBM.

It is contended in the brief that as the broadcasting art went forward, and the broadcast band became crowded with stations having fixed, definite locations, rendering dependable, regular service in all parts of the country, the need for portable stations grew less and less.

"It soon developed," the brief continued, "that not only was there no need for portable broadcasting stations, but that one portable station, because of its varying location, would ruin reception of a large number of fixed stations operating on the same channel, and on adjacent channels, and therefore the public would be deprived of the economical and beneficial use ofa channel to capacity, in terms of service to the listener."

Connecticut Factory Is Added by Pacent

The Pacent Electric Company, 91 Seventh Avenue, New York City, has increased its production facilities to meet increased business, according to James J. Ryan, treasurer. Mr. Ryan stated that business in May, 1929, in Pacent products was practically double that of the same month a year ago and that there was no let down in production during the Summer. Rather, he stated, the Company found it necessary to add an entirely new production plant in Connecticut to keep up with orders for the new Series 106 Phonovoxes, the new Pacent Electric Phonograph motor and other items in the Pacent line.

The new production unit in Connecticut is devoted primarily to the manufacture of the electric phonograph motor, small parts for the Phonovox, and other units in the Pacent line. There are 350 persons employed.

HOFFMAN JOINS SANFORD

Sanford Radio Corporation, 480 Canal Street, New York City, distributors of Cunningham tubes and other lines, announces the addition to its staff of Manuel Hoffman, formerly with Wireless Egert. Mr. Hoffman, widely known to the trade, will cover the metropolitan territory as assistant to Charles Ollstein.

CAUTION ABOUT TUBES

When many AC tubes are on one transformer winding do not remove a tube from its socket without first turning off the power.

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With Molded Wood Horn of 8 ft. tone travel (exponential type) with baffle and horn motor built in. Extraordinary bargain.

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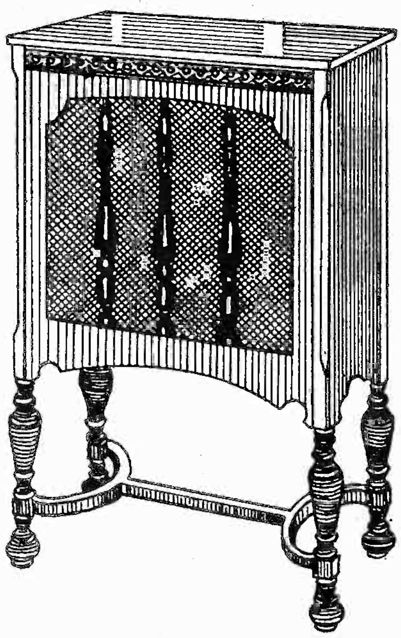

The speaker cabinet is walnut finish, 33" high, 24½". wide,. 17½". deep,. with. carved. legs. Golden cloth grille covers front opening. .Built inside is No. 595 molded wood horn with baffle and No. 203 driving motor unit that stands 250 volts without filtration. Horn and motor removable. Table alone is worth price asked. Remit with order and we pay cartage on Aristocrat Floor Speaker.

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T1, Ch1, Ch2—One Polo 245 power supply, consisting of one 12 amp. 2.5 volt winding, one 3 ampere 3 amp. 2.5 volt, one 5 volt, one 724 volt, all center-tapped; primary winding and two chokes; all in one cadmium-plated case	$10.00
C1, C2, C7—Three 2 mfd. HV filter condensers, 550 volts rms working voltage, @ $1.70	5.10
C3, C4, C5, C6—One Mershon electrolytic condenser, consisting of two 18 mfd. anodes and two 8 mfd. anodes, with mounting bracket	5.75
C8, C9—Two .01 mfd. mica dielectric condensers @ .35	.70
C10—Two HV filter condensers, 550 volts rms working voltage, connected in parallel @ $1.70	3.40
R1—One voltage divider: (1) to (2) 8 ohms, (2) to (3), 50 ohms, (3) to (4) 775 ohms, (4) to (5) 4,400 ohms, (5) to (6) 2,500 ohms.	1.75
R2—One .5 meg. metallized resistor.........	.30
R3—One 2 meg. metallized resistor.........	.30
R4—One 50,000 ohm (.05 meg.) metallized resistor	.40
R5—One 5 meg. metallized resistor.........	.30
Ch3—One output impedance	3.00
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Mounting bracket for C1, C2, C7, C10.......	.25
Speaker—Two binding posts @ .10	.20
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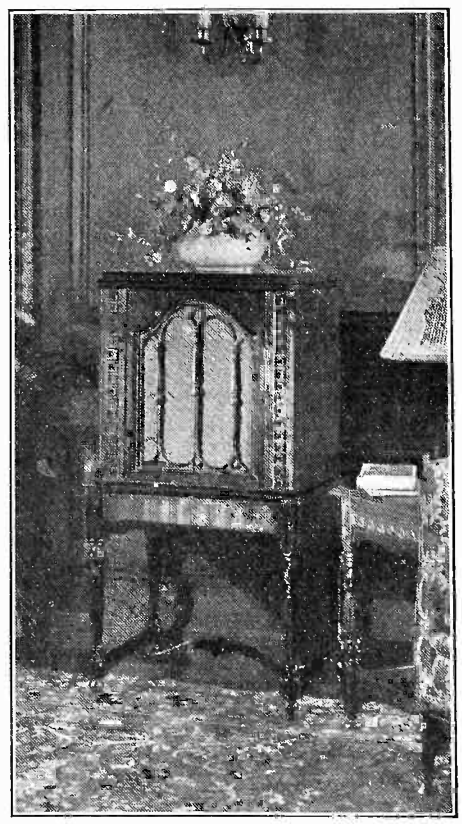

The famous Peerless AC dynamic speaker, with Kuprox rectifier and 1,500 mfd. hum-killing condenser built in, all housed in this 40" high Sonora cabinet of fascinating ply-walnut. The cabinet is all one piece—carved legs, marqueterie panel and grille pillars. Sliding back is made of cane. This imposing floor model speaker, exactly as illustrated, in original factory packing case, shipping weight 100 lbs. **37.50**

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Never in your life did you hear of such an amazing bargain—highest class, perfect, guaranteed merchandise at more than 75% off list price! Look at that beautiful highboy cabinet, its graceful legs, with archer's bow tiepiece; its rosetted side panels at front, its shapely grille pillars, all in two-tone effect, with high-polish surface of walnut. The speaker sets against a golden grille, with ample baffle board concealed.

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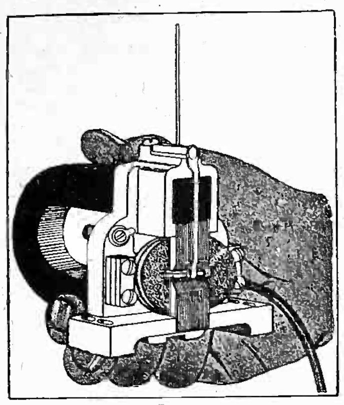

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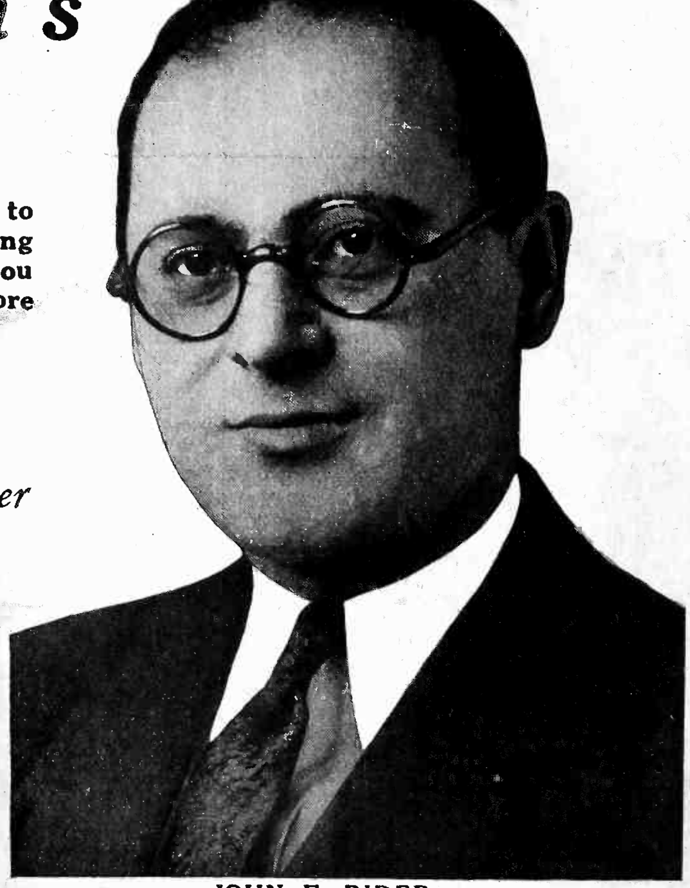

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60, 62, 20, 64, 30 105, 51, 16, 32, 6C, 25 A.C., 28 A.C., 41, Receptor S.P.U., 17, 18, 33.

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Type F series filament, type E series filament, type D series filament, Model K, Model H.

ATWATER-KENT
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CROSLEY
XJ, Trirdyn 3R3, 601, 401, 401A, 608, 704, B and C supply for 704, 704A, 704B, 705, 706.

ZENITH
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MAJESTIC
70, 70B, 180, power pack 7BP3, 7P6, 7P3 (old wiring) 8P3, 8P6, 7BP6.

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FREED-EISEMANN
NR5, FE18, NR70, 470, N R 5 7, 457, NR11, NR80 DC.

STEWART-WARNER
300, 305, 310, 315, 320, 325, 500, 520, 525, 700, 705, 710, 715, 720, 530, 535, 750, 801, 802, 806.

GREBE
MU1, MU2, synchrophase 5, synchrophase A C 6, synchrophase AC7, Deluxe 428.

PHILCO
Philco-electric, 82, 86.

KOLSTER
4-tube chassis used in 6 tube sets, tuning chassis for 7 tube sets, power amplifier, 7 tube power pack and amplifier, 6 tube power pack and amplifier, rectifier unit K23.

STROMBERG-CARLSON
1A, 2B, 501, 502, 523, 524, 635, 636, 403AA power plant, 404 RA power plant.

ALL-AMERICAN
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 60, 61, 62, 65, 66, 6 and 8 tube A.C. power pack.

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COLONIAL
26, 31 A.C., 31 D.C.

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 89.

MISCELLANEOUS
DeForest F5, D10, D17, Super Zenith Magnavox dial, Thermyodyne, Grimes 4DL inverse duplex, Gared neutrodyne, Gared EA, Ware 7 tube, Ware type T. Federal 102 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Armad inductrol.

Here are the 22 chapter headings:

- SERVICE PROCEDURE
- PRACTICAL APPLICATION OF ANALYSIS
- VACUUM TUBES
- OPERATING SYSTEMS
- AERIAL SYSTEMS
- "A" BATTERY ELIMINATORS
- TROUBLES IN "A" ELIMINATORS
- TROUBLE SHOOTING IN "A" ELIMINATORS
- "B" BATTERY ELIMINATORS
- TROUBLES IN "B" BATTERY ELIMINATORS
- TROUBLE SHOOTING IN "B" BATTERY ELIMINATORS
- SPEAKERS AND TYPES
- AUDIO AMPLIFIERS
- TROUBLE SHOOTING IN AUDIO AMPLIFIERS
- TROUBLES IN DETECTOR SYSTEMS
- RADIO FREQUENCY AMPLIFIERS
- TROUBLE SHOOTING IN RF AMPLIFIERS
- SERIES FILAMENT RECEIVERS
- TESTING, AND TESTING DEVICES
- TROUBLES IN DC SETS
- TROUBLES IN AC SETS

Some of the Questions Settled in Book:

Securing information from the receiver owner, list of questions, practical chart system of repairs, circuits and operating conditions.

Repairs in the home, method of operation, spare tubes, the process of elimination, recognizing symptoms, examples of practical application, tracing distortion, tracing electrical disturbances; vacuum tube tests; neutralizing systems, filament circuits, grid circuits, methods of securing grid bias, plate circuits; long aerials, short aerials, selectivity, imperfect contact, directional qualities, grounds; "A" battery eliminator types, design, operating limitations, requirements for perfect operation, AC eliminators, DC eliminators; "A" elminator hum, reasons, voltage, reasons, noise; full wave, half wave, B battery eliminators, filament rectifiers, gaseous rectifier, dry disc rectifier, wiring, parts used, design, voltage regulation, operating limitations, requirements for perfect operation, combination filament and plate voltage eliminators, AC and DC types; B battery eliminator output current and voltage, excessive hum, dead eliminator, poor design, reasons for defects, motorboating, punctured condensers, shorted chokes, voltage regulator tubes, function of filter system, C bias voltages, voltage divider systems, filter condensers, by-pass condensers, voltages in the system; determining voltages in B eliminators, AC, DC, voltage drop, effect of shorted filter system, defective rectifiers, defective transformer, defective chokes, defective by-pass condenser, design of filter system, defective voltage divider network, relation between hum and output voltage, isolation of troubles, external filters, noise filters; cone, dynamic, exponential speakers, troubles, dead, weak output, distorted output, rattle, continuity testing, windings, magnets, frequency filters, testing, chokes, condensers, hum elimination;! audio amplifier types, transformer, resistance, impedance, auto-transformer, combinations, requirements for perfect operation, operating limitations, tubes, forms of coupling, plate voltage, grid voltage, filament voltage, isolating condensers, voltage reducing resistances, noises, analysis of trouble, plate current, grid current.

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